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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

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The Works' Metallurgist.

The scope of the metallurgical chemist was dealt with by Dr. C. H. Desch, Professor of Metallurgy at Sheffield University, on the occasion of the Streatfield Memorial Lecture at the Finsbury Technical College. He made a strong plea not only for the more extensive employment of the metallurgical chemist, but also the advancement of this class to the directorates. To put it into Dr. Desch's own words:—"Many of us hold that the actual direction of the industry should be largely in the hands of such technically trained experts, and that the frequent absence of such direction is one of the most potent causes of weakness in the industry. The transfer of the control of manufactures from the technical chiefs to boards of financiers and commercial men is a serious fact of the day, deserving the careful attention of all who are interested in the relations of science and industry. It leads inevitably to concentration on finance rather than on manufacture, and to the making of profits assuming greater importance than the making of goods."

Whilst this is admirable in theory, and has quite often worked out well in practice, it should not be forgotten that in many cases the mentality of a metallurgist is entirely different from that of a financier. His early training is all against economy, and the lack of anything appertaining to costs is, in most cases, conspicuously absent from his curriculum. His first introduction to business is the checking of invoices, probably at the age of 21, at which time he is not conversant with the difference between these and a "statement." When, as sometimes happens, the high cost of "sodium bismuthate" or ammonium molybdate is questioned by the accounts department, the metallurgical chemist resents this, as he imagines it to be interference. This typical attitude impairs his advancement on the business side early in his career. The Universities should impress upon all students their sphere in the works on the business side, just as much as on the technical side. The debutant metallurgist should be in a position to demand grants for his routine or research work, and to do this with a knowledge of what the work is reasonably likely to cost. Whilst going further than Dr. Desch and asserting that where metallurgists have won for themselves the appellation of "captains of industry," they have been a conspicuous success, they have earned it, not on account of their metallurgical training, but in spite of it. We emphasise this plea for some business training to be included in every metallurgical course, as we feel sure, that if properly presented it would modify materially the aspect of much research work. Instead of producing complete details of the mechanism of the alloying of two metals, the research would be stopped after ascertaining the salient points and other work, having commercial possibilities, would be undertaken. The former could be left to the pure physical chemist as distinct from the metallurgist, and any data should be presented to physical and not metallurgical societies. We believe this course to be essential, as there is so much work of industrial interest which is so pressing that metallurgical societies have little or no time for academic research. The previous pleas which we have made for both practical and academical workers to become technical have been misunderstood by some, as they failed to differentiate between technical and academical. That there is such a difference can be exemplified by again quoting Dr. Desch, who says: "The degree of accuracy required in such analyses (high-speed steel and the like) for commercial and technical purposes is surprising to a chemist unaccustomed to such work, and is far in advance of the standard usually accepted in academic laboratories." Here, again, it is the non-realisation of commercial and practical conditions, which render the academical man's communications to technical societies so uninteresting, and necessitates their re-education, so as to include commercial aspects. Unless this is realised in the future, business men will withdraw their support from institutions which churn out year after year physico-metallurgical investigators of no industrial application, and will spend their money in private research laboratories, and so the amount of co-operative research which should be of the greatest value will diminish to the detriment of industry at large.

Coke Requirements of the Iron Trade.*

By A. Young.

General Requirements.

Foundry managers require a coke which will be freely combustible for cupola practice. Combustibility can be defined as a measure of the speed with which the carbon present in the coke will unite with oxygen under the given conditions.

The following factors affect the combustibility of the coke used for metallurgical purposes:—(*a*) Influence of graphite coating or film on the pores of the coke; (*b*) volatile matter left in the coke; (*c*) porosity; (*d*) areas of internal surfaces of cells, and (*e*) character of cell structure.

Coke is known to be a fairly incombustible substance compared with, say, charcoal, and the incombustibility is primarily due to the fact that in the distillation of coal a film of graphite carbon is deposited in the coke cells. This film is caused through the breaking up of the volatile products of distillation in their passage through the hot coke in the coke oven. This film is not easily combustible, and prevents combustion of the coke substance to some extent, as it acts as a protection against solution by carbon dioxide. The amount of volatile matter left in the coke affects the ease of ignition only.

When dealing with the last three factors, it must be remembered that the structure of coke has been considered from three points of view, porosity, density and reactivity.

As will be shown later, porosity and density are reciprocal, and the ratio of relative volumes occupied by the coke substance and the "cells" in the coke is calculated from the specific gravities, but the porosity figure thus obtained gives us no idea of the areas of the internal surfaces of the cells.

For this information it is required to know:—(*a*) The size of the cells; (*b*) their number and distribution: and (*c*) thickness of coke walls between them.

The influence of the reactive surfaces within the coke mass, on combustion, has been understood to be a function of the porosity, as it was thought it was necessary to secure free access of the oxidising gases and free removal of the products of oxidation to obtain full advantage of the reactivity of the internal surfaces.

Necessary Properties.

Therefore, it can be said that the combustibility will be greatly affected by the cell structure of the coke: the dimensions of the cells, and the continuity of the cell structure, also exercising considerable influence.

Therefore, a foundry coke must have the following properties:—

Physical.—I., well developed cell structure; II., sufficient hardness: III., proper size: and IV., non-friability.

Chemical.—I., large carbon content; II., low ash content; III., low sulphur and phosphorus content: and IV., low moisture content.

Laboratory Physical Tests.

These tests include the determination of:—(1) real specific gravity; (2) apparent specific gravity: and (3) porosity.

The *real* specific gravity is determined by using a known weight of finely ground coke in a specific gravity bottle, the bottle being first weighed filled with water and again when containing the known weight of coke and water not displaced by it. Air bubbles in the submerged coke must be removed.

The *apparent* specific gravity is found by suspending a fairly large piece of dry coke by a fine thread from the hook of a balance pan and weighing first in air and then in water. The weighing must be accomplished as rapidly as possible to prevent the water displacing the air from the pores of the coke.

The porosity is obtained as a percentage from the formula:—

$$\frac{\text{Real Specific Gravity—Apparent Spec. Grav.}}{\text{Real Specific Gravity.}} \times 100.$$

Chemical Laboratory Tests.

These consist of the estimation of:—(1) Moisture; (2) volatile matter; (3) ash; and (4) sulphur. The tests for these will be found in most text-books on fuels.

The ash may be separately estimated for:—(*a*) Silica; (*b*) alumina; (*c*) iron oxide; and (*d*) phosphorus and other compounds and elements.

To many users of coke the constitution of the ash is an important matter, as when coke is used in furnace work the constitution of the ash determines the liability of the coke ash to form clinker, and, when used for metal melting, impurities are apt to be absorbed by the molten metal from the ash constituents.

Practical Methods for the Testing of Coke.

The crushing strength of coke is not a satisfactory test for its hardness when judged from the ironmaker's point of view, as he requires a coke which has not only a hard cell structure, but a coke which, although it may break up from the large lump to smaller pieces, will not crush down to small stuff and cause blocking of the cupola. At the present time there is no universally accepted method of mechanically testing coke, but certain tests have been proposed by interested parties in this country. Mr. G. D. Cochrane, Mr. G. Jones and Mr. G. W. Henson have each invented machines for testing the coke hardness.

The machine used by Mr. Cochrane, designed for him by Mr. Jones, consists of a drum with two angle bars fixed inside to turn the coke sample over. The sample to be tested weighs 56 lbs. in lumps up to the size of a man's fist. The sample is dried on hot plates for 24 hours, and 28 lbs. of the dried coke is placed in the drum, which is given 1,000 revolutions at the rate of 18 revolutions per minute. The sample is then sieved over a $\frac{1}{2}$-in. mesh, and the quantity remaining on the sieve is stated as a percentage of the original 28 lbs., and is called the hardness of the coke.

Mr. Cochrane found as a result of his tests that the output of his blast furnaces fell as the "coke hardness" fell. When the hardness was between 74 and 76 he had very little trouble, but when the hardness fell below 74, the output of the plant fell considerably.

The "shatter test" has received a large amount of favour in the United States, being adopted by the Bureau of Mines, and is used to determine the relative breakage of the coke. It consists, usually, of dropping a known weight of coke on to an iron plate from a height of 6 ft. The apparatus consists of a box having a capacity of 100 lbs. of coke, mounted on supports, the cast-iron shatter plate being 6 ft. below the bottom of the coke box. Boards about 8 in. in height protect the edges of the cast-iron plate against loss of coke. The bottom of the coke box is provided with hinged doors which are held closed by a latch and are arranged to swing open freely, when the latch is released, thus permitting a free fall for the coke.

A sample of approximately 50 lbs. of lump coke is placed in the box, and the sample is dropped four times on to the cast-iron plate, the small material and dust being returned to the box with the large coke after each drop. After the coke has been dropped on to the plate four times, it is screened over a 2-in. mesh screen. The coke remaining on the screen and that passing through being weighed separately, thus determining the amount of breakage.

Carrick Anderson gave the following specification in terms of maximum percentages to be fulfilled by a coke employed for iron melting:—Water, 1 per cent.; ash, 9 per cent.; dust on delivery, 6 per cent.; phosphorus, 0.018 per cent., and sulphur, 1 per cent.

In addition there should be for blast furnace coke 40 to 50 per cent. pore space, or for foundry coke, 25 to 40 per cent., and hardness of 1,140 lbs. per sq. in., or 80 kgms. per sq. cm. The weight of 1 cub. cm. of the coke (dried at 100 deg. C.) should be 0.8 to 0.9 grs. (equal to from 13 to 14.75 grs. per cub. in.).

* Paper read before the Lancashire Branch of the Institution of British Foundrymen.

In 1915 the American Society of Testing Materials looked into the question of a foundry coke specification, and due to the difficulty of formulating definite standard specifications for beehive and bye-product coke covering a sufficiently wide scope, they decided to direct their work along four lines, including:—(1) Methods of sampling; (2) standard methods of chemical analysis; (3) standard methods of physical testing, and (4) standard specifications for foundry coke.

As a result, only tentative specifications for foundry coke were presented, owing to the wide variations in the chemical and physical requirements of the coke used for various purposes.

American Investigations.

Progress was made toward the adoption of uniform standard methods of analysis by co-operation with the joint committee on Coal Analysis of the American Chemical Society, and the Coke Analysis Committee of the American Foundrymen's Association, and uniform standard methods were expected to be available by the next year. Considerable attention to the various physical tests of coke were given by the committee. These included crushing strength, shatter test, porosity, specific gravity, etc., and the conclusion was arrived at that the compressive strength as determined on 1 in. cubes is worthless as a means of comparison, and that in general the relation between results of physical tests of coke and its value in practical use is too definite to include quantitive expressions of physical properties in standard specifications.

Thaler in 1915 made an investigation into the valuation of coke, and remarked that cokes for foundry and blast furnace use are differentiated in practice, but there is very little difference between them in reality. Coke for foundries should be the largest and best pieces, and as a rule, should contain less moisture and sulphur.

German Investigations.

A table showing the quality of coke required by the German Foundrymen's Association is given. This allows a moisture content of 5 per cent., which, in Thaler's opinion, is too high. The moisture content is largely dependant on the physical structure of the coke, a good hard quality being preferred as this carries less moisture than a softer coke. The phosphorous in the coke is almost entirely taken up by the iron, therefore, this should not exceed 0.04 to 0.05 per cent.

The physical properties as well as chemical composition should be taken into account in classifying cokes.

The principal points to consider are:—

(1) *First-class Coke.* Silver white lustre, sinewy structure, dense, firm with metallic ring, resistant to pressure, should not break into small pieces when falling, or contain more than 8 per cent. ash, 3.5 to 4.0 per cent. moisture and 0.8 per cent. sulphur.

(2) *Second-class Coke.* Faint white to dark lustre, structure more boney and porous, and less resistant to pressure than (1), should not contain more than 10 to 11 per cent. ash, 8 to 9 per cent. moisture and 1 to 1.1 per cent. sulphur.

TABLE I.—*Meissner's Table of Physical Tests for Blast Furnace Coke.*

Coke made from mixtures of American coals in proportions.	Shatter test.		Specific gravity.		Porosity or percentage of cell space.
	Through 2 in. screen.	On 2 in. screen.	Apparent.	True.	
80% Pocahontas 20% Ronco	15.6	84.84	0.976	1.841	47.03
80% Pocahontas 20% Ronco	16.11	83.89	0.950	1.824	47.92
60% Pocahontas 40% Ronco	14.06	85.94	0.992	1.834	46.31

(3) *Third-class Coke.* Lustreless, grey black, fracture, soft, breaking easily when struck; the individual coal particles are easily distinguished; highly porous and holds water tenaciously. It has a low density, 9 to 9.5 per cent. ash, 13 to 15 per cent. moisture and 1 per cent. sulphur.

Mr. C. A. Meissner gives as good physical coke tests for standard quality of blast furnace coke the figures set out in Table I.

Cupola Troubles in Relation to Coke.

The coke is sometimes blamed for cupola troubles for which it is not the cause such as:—(1) Defects in the practice of the operator; (2) excess of air due to too high blast pressure; (3) blocking up of tuyeres and (4) change in source of coke supplies without any modification in working of cupola to meet the altered quality of the coke.

A fuel, high in ash content, will give a greater unburnable residue, and thus cheapness in price may be more than discounted by the extra amount of coke required for melting, and the additional amount of slag resulting.

According to Mr. L. E. Gilmore, a consulting metallurgical engineer in U.S.A., malleable cupola practice requires a larger amount of fuel per ton of iron melted than does grey iron, due to the higher temperature required to run thin sections and to lower percentages of phosphorous and silicon. For the malleable range he gives a coke to iron ratio of from 1 : 4 to 1 : 5.5. Attempts to exceed 1. to 5.5 result in liability of dull iron. The amount of coke in the bed and between the iron changes must be so proportioned that the iron fuses high in the melting zone, producing iron of the required temperature and causing slower rate of melting than is the cause with grey iron when using less fuel.

The speed of melting can be increased or diminished within limits by varying the blast pressure, but large increases in blast pressure must be accompanied by additional fuel for the bed, as the melting zone is forced higher in the cupola. A 6 to 12 oz. pressure should give hot-melting but 16 oz. or over, shows excessive clogging of cupola by slag, or too tightly packed materials such as finely divided coke or scrap iron.

Coke Economy in Relation to Cupola Practice.

The heat generated is employed as follows:—(1) For melting the iron, fluxing the impurities and providing the extra heat necessary to enable the iron to remain sufficiently fluid for the moulder; (2) to compensate for the heat losses:—(a) Radiation from cupola; (b) sensible heat in waste gases, and (c) heat lost in unburnt carbonmonoxide.

To obtain economy in coke consumption it is necessary to cut down the heat losses to the smallest extent, although the coke consumption depends on other factors as well.

Radiation Losses.

These will be small compared with (b) and (c), but will be diminished by having a minimum of radiating surface in relation to output.

Sensible Heat in Waste Gases.

The gases leaving the combustion zone of the cupola will do so at a high temperature, and as much of their heat as possible should be taken up by the descending charge, otherwise, such heat is lost to the cupola.

In order to prevent as much of this loss as possible, maximum amount of contact between the charge and the hot gases per unit of time is necessary. Thus in high and narrow cupolas, the path of the gases is longer and their velocity greater, and according to Mr. H. J. Yates*, the relation of diameter to height should not fall below a certain figure, also, high and narrow forms of cupola are preferable for this reason.

Heat Lost in Unburnt Gases.

It is impossible to completely eliminate this loss entirely, but the causes of such loss should be examined and remedied. They are:—(1) Insufficient blast; (2) improper settling of charge due to broken linings or irregularities in charging and (3) faulty air distribution of air at tuyeres.

In the first case the trouble is due to lack of oxygen to complete the combustion process, and in the second and third cases, improper distribution of the air throughout the charge, with the possibility of the carbon monoxide being cooled below its ignition temperature in certain parts of the cupola.

It is well known that excess of coke not only reduces the economy of the plant, but will also affect the speed and regularity of the melting, and

*British Association Fuel Economy Committee.

therefore, experiments may be made with advantage in reducing the coke charge until the best results are obtained.

There are, of course, many other points by which economy of coke may be obtained, as by attention to the various constructional points in cupola design, and by the general methods of manipulation, which are the every day business of the foundry manager, but are outside the scope of this contribution.

APPENDIX.

Determination of Phosphorus in Coke.*

The determination of phosphorus in coke recommended by the American Foundrymen's Association is as follows:—

Five grs. of coke are ignited either in a platinum dish or large platinum crucible until all carbon is burnt off, after which 10 c.c. of 50 per cent. hydrochloric acid and 20 c.c. of hydrofluoric acid are added; the sample is then evaporated to dryness, and ignited at a dull red heat. The residue is fused with about 3 grs. of sodium carbonate and 0.3 gr. of potassium nitrate, cooled, and the dish containing the fusion is placed in a beaker of water and boiled. When the fusion has been completely dissolved, the dish is rinsed into the solution and then laid aside.

The solution is next acidified with hydrochloric acid, precipitated with ammonia, boiled, filtered and washed with hot water. The precipitate is dissolved by washing the filter with warm dilute nitric acid, but if it should not dissolve under this treatment, it should be washed with warm dilute hydrochloric acid until it does dissolve. If the latter operation becomes necessary the solution must be evaporated to a volume of about 5 c.c., after which about 30 c.c. of 1.20 sp. gr. nitric acid is added, the solution is again evaporated to about 5 c.c. and 30 c.c. of nitric acid (1.20 sp. gr.) is again added. The solution is now heated to between 70 deg. C. and 90 deg. C., and 50 c.c. of molybdate solution is added; this solution is stirred for a few minutes, filtered and washed 5 times with a 3 per cent. nitric-acid solution, and 5 times with a 0.1 per cent. potassium nitrate solution. The precipitate and filter is now transferred to the flask in which the precipitate was made.

Here 30 c.c. of water are added, followed by a $\frac{N}{5}$ solution of sodium hydroxide from a burette until the latter is in excess, the solution being constantly agitated. After the yellow precipitate has been entirely dissolved 0.1 c.c. of phenolphthalein solution is added as an indicator, and the result is then titrated with $\frac{N}{5}$ sulphuric acid.

The following calculation will then give the percentage of phosphorus present:—

1 c.c. of $\frac{N}{5}$ NaOH = 1 c.c. $\frac{N}{5}$ of H_2SO_4 × 0.0054 = percentage of phosphorus.

The molybdate solution is made by adding 100 gr. of molybdic acid to 250 c.c. of water, after which 150 c.c. of ammonia is added, this mixture is then stirred until all is dissolved, after which 65 c.c. of nitric acid (1.42 sp. gr.) is added. Another solution is now made by adding 400 c.c. of concentrated nitric acid to 1,000 c.c. of water; both solutions are allowed to cool, and the first solution is then slowly poured into the second, constantly stirring the mixture, after which a few drops of ammonium phosphate are added.

* From "Coal and Coke," by Wagner.

The Design and Construction of Runner Heads.

By M. J. COOPER.

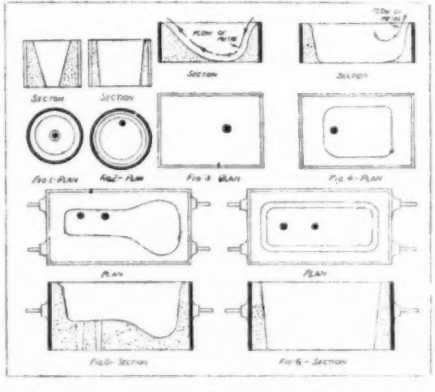
It would be safe to say that more castings are spoiled by careless pouring and badly-designed runner heads than by faulty metal or defective moulds, and the majority of burning accidents may be traced to the same source.

Having decided the best situation for the pouring or runner head in relation to the crane and general surroundings, the form and size the runner head shall take must then be fixed upon This will be governed more or less by several circumstances; the position of the down-gate on the moulding box, the weight of the casting, and the area of the runner, also the size of the ladle to be employed.

However well-constructed a runner may be, if it be so placed about the down-gate that the metal may form a vortex or whirlpool, as in Fig. 1, there is a grave risk of dirt entering the mould along with the metal at the time of pouring. The action and effect of a whirlpool in relation to casting or pouring may find fitting demonstration by observing the water passing down the waste pipe from the bath or wash basin, and any form of circular runner head is a source of danger unless considerable care is used when pouring, but a circular runner head made and placed about the down-gate, as shown in Fig. 2, is acceptable.

A runner head should never take the form of a saucer or basin, and it is bad practice to have the down-gate occupy the centre of the runner head, or for it to be placed directly under the fall of the metal when pouring (see Figs. 3 and 4).

When constructing a runner head, the retaining walls of sand should be as vertically straight as possible, and it is an advantage to make them



slightly undercut. A runner head should never be harder than a mould. A hard-rammed runner will cut and scab just as freely as a mould similarly made.

Once pouring commences, the runner head should be filled as quickly as possible, and, when filled, it should be kept at a constant level until the metal appears in the risers.

With a properly-made runner head and the ladle in competent hands, splashing of metal should never occur, and it may be truly said, "with much splashing, there is much waste and many wasters."

It is frequently seen with the first entry of the metal into the runner head a spray of shots, then a pause in the pouring, to make sure all is well personally, and as frequently a succession of splashes and pauses, so that the mould has been filled by a series of splashes instead of being truly poured, and neither skimmer nor skimming-gates under these circumstances will prevent dirt entering the mould along with the metal.

This state of things may be brought about in several different ways: the runner head may have been moulded in the form of a saucer, so that the metal is "switchbacked" over the opposite side, or the bottom of the runner is so placed that the metal drops where a flat-rammer has left its firm impression, or the damp bar of the top box has been left exposed, in which case further trouble is likely to follow, for the molten metal may melt and adhere to the bar when cool, to the consequent damage or destruction of the box part, for, if not actually adhering, the concussion of breaking the head when cold will break the bar.

Endeavour at all times to restrict the size of the head; in other words, design a runner head for utility and economy (see Figs. 5 and 6), and when placing a runner or runners at the onset of the job, try to visualise the form and size of the runner head necessary. It will then be known almost from the commencement of the job exactly the runner box required, and, within reasonable certainty, where to lay hands upon it.

The Steel Foundry of Messrs. Thwaites Brothers.

Any description of this old-established Bradford engineering works must be read bearing in mind that it is situated in a congested area, and no opportunity is afforded for including all that is best in modern lay-outs. In such works, however, great ability can be shown in the devising of labour-saving mechanisms of an original character, and it is in this direction that the Vulcan Works prove so interesting.

The steel foundry has been laid out primarily for the manufacture of repetition castings, but specialising in motor-omnibus and lorry wheels.

The Foundry Proper.

The foundry itself is housed in three bays, each being 160 ft. long by 35 ft. wide. It is provided with one 5-ton and six 2-ton Morris electric overhead cranes. Liquid metal is supplied by three 2-ton single-phase Snyder electric furnaces. A full description of this plant was given in a Paper presented to the West Yorkshire Metallurgical Society by Messrs. H. P. Abel, A. A. Liardet, and W. West, and was reproduced in our issue of June 1, 1922. A point, however, which was not mentioned in the Paper was that the furnaces are provided with slagging notches, which effectually keep back the slag and allow of the use of lip-pouring ladles, whilst still ensuring castings free from slag inclusions. For some work, however, the bottom-pouring ladles are still utilised.

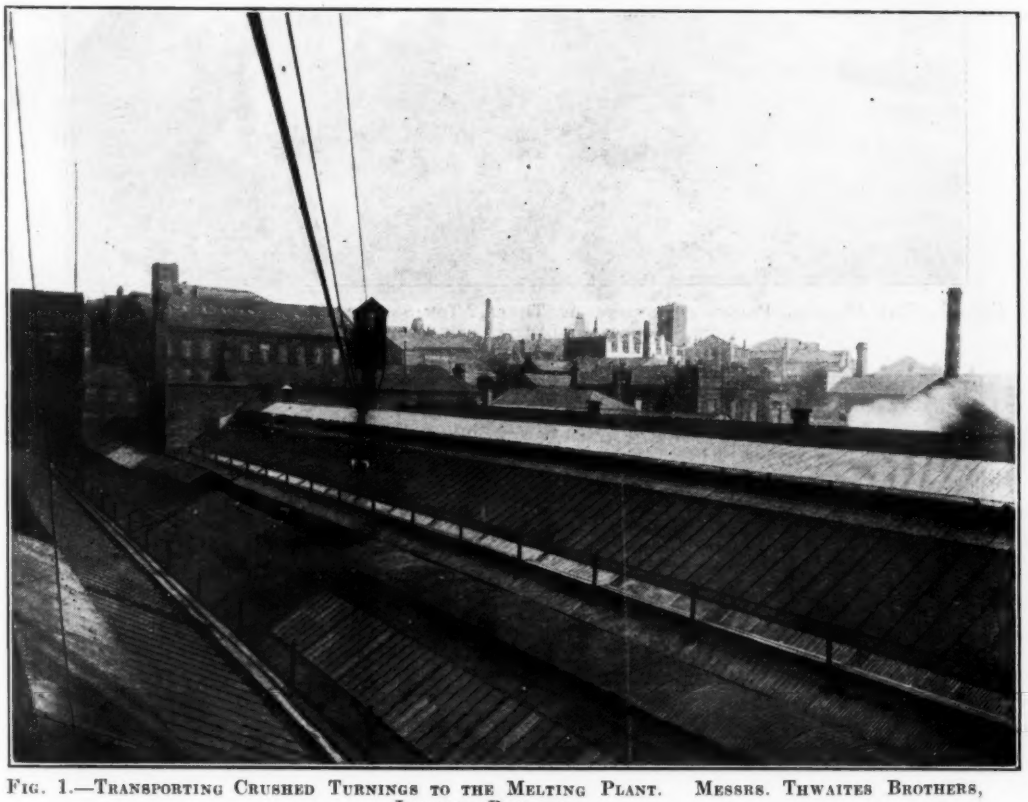


FIG. 1.—TRANSPORTING CRUSHED TURNINGS TO THE MELTING PLANT. MESSRS. THWAITES BROTHERS, LIMITED, BRADFORD.

Reception of Materials.

For such a plant the chief raw materials are steel turnings of good quality, on account of the furnaces being acid, slag-making materials, alloys, and sands. Being very strong advocates of scientific control, nothing is left to chance and all raw materials are examined both chemically and physically. Two laboratories, under the care of Mr. W. West, tackle this problem systematically, as any laxity only provides more work at the other end of the scale, as the finished castings or test pieces from them are subjected to chemical analysis, heat treatment, and mechanical testing.

The Physical Laboratory.

This department is equipped with a 30-ton Buckton testing machine, which can be used for ascertaining the tensile strength of steel and the crushing and transverse strength of cast iron. The useful Brinell, a Foster impact, an Avery concrete tester for ascertaining the mechanical strength of cores and refractories are not merely installed but are constantly in use, as is evidenced by the large number of daily results shown to our representative. In an adjoining room a Swift microscope provided with an optical bench for photo-micrographic purposes is installed, whilst another bench supports a Cambridge recording pyrometer, which at the time of our visit was recording the thermal history of four annealing ovens.

The Chemical Laboratory.

This is a white-tiled, roomy department. It is divided into three sections—the laboratory proper, the balance room, and, what is of equal importance, the library and conference room. To the last the melting shop and foundry foremen have full access, and it is here that the co-operation of the technical and practical staffs takes effect by weekly conferences. The actual laboratory is in every respect modern. It is well designed, and the chemists enjoy immunity from the smells associated with steel analysis by an excellent system of ventilation.

Transport of Turnings.

As pointed out, the Vulcan Works is situated in a congested area, and this factor prevented the unloading of the turnings in close proximity to the furnaces. They arrive some distance from the melting shop, and are crushed in a pug mill in order to allow of their being more easily charged into the furnaces—a very advisable practice. They are then transported by an aerial ropeway, illustrated in Fig. 1, to a convenient situation beneath the melting shop.

Preparation of Sands.

Messrs. Thwaites realise the importance of standardising sands, and the first step taken is

to dry all new sand in a drier of their own design. This is of the rotary kiln type, and is illustrated in Fig. 3. The facing sand is prepared from a mixture of "Yorkshire" and Mansfield.

Fig. 2.—The Melting Plant, consisting of Three 2-Ton Snyder Furnaces. Messrs. Thwaites Brothers, Limited, Bradford.

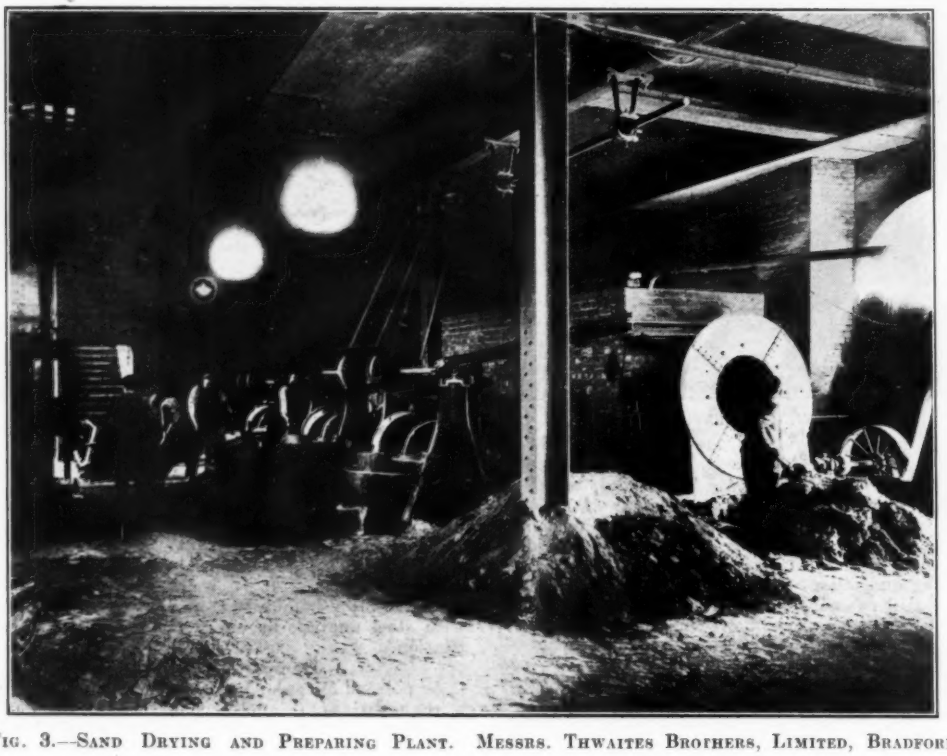


Fig. 3.—Sand Drying and Preparing Plant. Messrs. Thwaites Brothers, Limited, Bradford.

Moulding Details.

The wheel-moulds are made on 12 "Britannia" jar-ramming machines. Additionally there are 8 hand ramming turnover machines. The majority of moulds are skin-dried by means of town's-gas-fired burners. There is, however, an externally-fired mould-drying stove to cater for larger work.

Core Shop.

A view of this shop is given in Fig. 4. It is entirely staffed by women coremakers. Oil-sand cores predominate, and are made up with the Fordath preparation as a binder. The mixture is maintained at an elevated temperature to ensure the necessary fluidity to enable each grain of sand to be equally coated. Amongst a variety of core-making machines our representative particularly noticed the one illustrated in Fig. 6. It is a simple arrangement made by the firm, and turns

out half-cores on boards ready for drying. The core stoves used are more substantial than those usually employed, being of brick construction. They are coal-fired, and some are arranged to take bogie wagons.

Spinning Bushes.

By the side of the melting furnaces an interesting centrifugal casting plant has been installed. This arrangement has been entirely successful, but expansion to a mass-production is problematic

FIG. 4.—GENERAL VIEW OF THE CORE SHOP. MESSRS. THWAITES BROTHERS, LIMITED, BRADFORD.

FIG. 5.—ONE OF THE THREE BAYS OF THE FOUNDRY. MESSRS. THWAITES BROTHERS, LIMITED, BRADFORD.

Heat-Treatment Plant.

This department contains three large annealing furnaces; two are by the Incandescent Heat Company, which have been modified to meet the special conditions obtaining, and a removable roof has been incorporated to facilitate charging. A third is of the reverberatory type. All are pyrometrically controlled from the physical laboratory.

owing to the difficulty of maintaining hot a reservoir of liquid steel on which to draw. The machine is initially rotated at 400 r.p.m., and is increased to 1,000. We have elsewhere stated that, with the exception of alloys containing two ingredients of very divergent specific gravities, centrifugal casting is beneficial. Our representative was shown a bush made from a mild steel of

approximately the following composition: C, 0.08; Si, 0.04; and Mn., 0.08 per cent. This steel, if poured normally, would have given a honeycombed ingot or casting, but which, when spun, made a quite solid bush of exceptional softness. The chills into which the liquid steel is poured, are made of hematite iron and last several hundred heats, after which they deteriorate through pitting.

General.

As stated, a speciality is made of lorry and omnibus wheels, and this specialisation does not stop at the foundry. The fettling shops, which are replete with sand-blast apparatus, have many arrangements specially devised to facilitate mass production. In the large modern machine shops solely devoted to the production of wheels, the hub centres are broached instead of being turned.

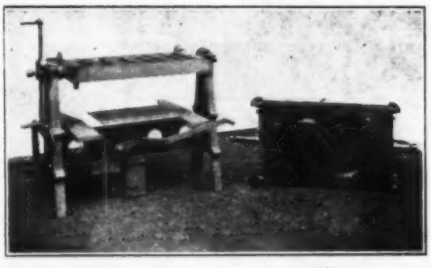


Fig. 6.—A Core-Making Machine. Messrs. Thwaites Brothers, Limited, Bradford.

Spraying machines are used for painting purposes previous to despatch.

Welfare Department.

The works possesses an excellent dining-hall, which is much appreciated by the operatives, whilst a modern ambulance room is under the constant care of a trained nurse. It is interesting to nofe that the dining hall is utilised as a lecture theatre for the instruction of both adults and apprentices. The interest which Mr. Liardet, the managing director, takes in the apprenticeship question is well known.

Importance of Temperature in Bessemer Converters.

The German metallurgist, Herr Otto Holz, of Oberhausen, has recently called attention to the influence exerted by the temperature of the metal, when charged into the converter, on the behaviour of basic pig-iron during the blowing process. It is a well-known fact that the blowing of charges is always more troublesome after the week-end rest, when the metal in the mixers has a tendency to become cold than when, with the work in full swing, the mixers are barely able to meet the demands of the converters. Dissenting from the opinion that certain difficulties in working were due to the chemical composition of the iron, Herr Holz maintained that the trouble was most often due to greater viscosity of the metal consequent upon its low temperature. In support of his contention, he adduces the experience gained at the Kladno Works, where an iron containing Si up to 1 per cent., Mn 0.1 per cent., P 2-2.4 per cent., and S 0.06, was blown without any trouble before the war, and the experience at the Neuenkirchen Works, where a pig-iron with the analysis: C about 3 per cent., Si 0.28 to 0.35 per cent., Mn 0.1 to 0.14 per cent., P 1.75 to 1.85 per cent., S 0.08 to 0.12 per cent. was equally satisfactorily dealt with. In both these plants the iron was, owing to special conditions, poured into the converter at a very high temperature, and the resulting steel was of first quality and could be used for the manufacture of wire and weldless tubes.

Herr Otto Holz, from his own practical experience and from a study of the results communicated to him by other experts in basic Bessemer works, concluded that it was possible to blow, with excellent results, irons having widely different chemical compositions, including even those formerly considered unsuitable for use in converters, provided that the metal was made very hot. He has proved that if a metal is viscous owing to its low temperature, even if high in Mn and particularly if high in Si, the blowing time may be prolonged by three to eight minutes; that the slag may contain from 12 to 14 per cent. of iron, and that the risk of ebullition may become so serious as to require a reduction in the usual blast pressure. For a metal of similar composition, but very hot, on the contrary, the duration of the blow may be reduced by 20 to 25 per cent., and is, consequently, under perfect control, the risk of ebullition is almost nil and the iron content of the slag is easily kept down to from 8 to 10 per cent. In consequence of this experience the author is inclined to consider the question of sensible heat of such importance, from the point of view of economy, that, making due allowance for the extra cost of the operation, he deems it worth while to allow the molten metal to remain a short time in an open-hearth furnace, in order to allow it to acquire the extra 50 degrees or so before charging it into the converter. It is just this small difference in the temperature (between 1,190 to 2,000 deg. and 1,250 to 1,260 deg. C.) which Herr Holz considers sufficient to make all the difference between a "physically hot" and a "physically cold" metal.

A French Criticism.

M. Andre Cornu-Thenard has the following comment on this in a recent issue of the "Revue de Métallurgie":—

The views propounded by Herr Holz on this subject have aroused a keen interest among steel-makers beyond the Rhine as proved by the number of speakers who have taken part in the discussion and their repute in the steel industry. In France the Compagnie de Chatillon, Commentry and Neuves-Maisons, has carried the matter even farther, and, following upon the experimental work done by M. Kerschen, the engineer at Neuves Maisons, patented in 1919 a process ensuring the supply in regular working of a very fluid hot pig-iron low in Si and Mn, and giving, in the converter, results equal and sometimes even superior to those obtained by Herr Holz. The process adopted at Neuves Maisons and used now for several years results in considerable economy in manganese, and is briefly as follows:—The iron, made in the blast furnace in accordance with the patented process, is passed into a mixer of 600 tons capacity, fired with blast-furnace gas. On leaving the mixer the composition of the iron is about as follows:—C, 3.25 to 3.40; Si, 0.30 to 0.45; Mn, 0.5 to 0.7; P, 1.90 to 2.00; S, 0.040 to 0.070 per cent. It is then charged directly into a converter at a temperature of nearly 1,300 deg. C., and blown from 10 to 12 minutes, the blast pressure being about 25.5 lbs. per sq. in. at the beginning; this is quickly increased up to about 31 to 35.5 lbs. per sq. in., at which pressure it is maintained till the finish. The average iron content of the slag is about 7.70 per cent.; that of manganese does not exceed 3.5 to 4.00 per cent., whilst the loss by ebullition during the blow is extremely low.

German Iron and Steel Industry.

The open-hearth steel plant at the Peine rolling mills is shortly to be shut down owing to the high cost of English coal, upon which the plant is dependent.

Negotiations are proceeding between 52 works of the railway wagon construction branch for the formation of a syndicate, and a decision is expected to be reached this week.

The French Group which was formed to acquire 15 per cent. of the share capital in the Silesian Hohenzollern Works, is reported by the Polish newspapers to have exercised an option on a further 15 per cent. of the shares. The Group was constituted by members of the Comité des Forges in their private capacity, and these are also said to be interesting themselves in the Kattowitz Company, and the Königs and Laura Works. Franco-British companies are also declared to be in process of formation in Paris with the object of developing Upper Silesian works.

Mr. Harris Abrahams, Mansell Street, E.1, has established a tinplate and metal department at 4, New London Street, London, E.C.3.

Defects in Brass Tubes.

At a meeting of the Birmingham University Metallurgical Society, held at the University on October 31, some important conclusions and suggestions based on works practice were given in a Paper entitled "Some Defects Occurring During the Manufacture of Brass Tubes," by Mr. W. E. Ballard. Confining himself to 70:30 tubes, the author dealt with failures as classified under three headings: Faults of Castings, Faults of Annealing and Faults of Drafting.

Casting, Mr. Ballard said, was a process which could be very productive of failures, and it was sometimes blamed more than it deserved. The inside surface of the tube casting depended largely on the suitability of the core and the outside on that of the mould and its dressing, whilst the wall of the tube would be prey to all the ills inherent in solidifying metals. Obviously a tube would be useless if any of the sand of the core crumbled away and became entangled in the metal or if the metal ran through the core. It was surprising how few tubes suffered in such a way, but the trouble when it did occur might be due to too little binding material being used in the sand mixture, or to the cores having been dried at too high a temperature, perhaps in the neighbourhood of 150 deg. C., in which case they would almost always show cracks before being placed in the mould. Another cause might be rough handling after leaving the stoves. Roughness due to the molten metal biting into and fritting the sand usually occurred at the place where the metallic stream impinged upon the core. To prevent this the cores were dressed before their final drying with a wash usually of powdered charcoal in a weak solution of binding material. Large holes in the tube were usually due to badly-dried cores, or to a spot of water having fallen on the core just before it was placed in the mould. It was unnecessary to point out that under-drying of cores might lead to serious accidents. Core troubles might be overcome completely when a satisfactory steel or metallic core could be introduced.

Mould Dressings.

In considering defects of the outer surface they came to the vexed question of mould dressing. Very little work of a scientific nature had been done on this subject. Mould dressings for tubes usually had two components, (*a*) an oil liquid, and (*b*) a thickening medium. The latter was usually finely ground charcoal, graphite or anhydrous clay. Probably charcoal was the most generally used. Graphite was slightly more expensive, but was inclined to make the moulds dirty. Dehydrated clays needed very careful attention. Clays had a tendency to pull together and to give uneven coatings on the moulds. Small clay particles were also apt to get trapped in the metal. It was with regard to the oil base that one found the great difference of opinion. Weird and wonderful were some of the mixtures used. It was a common thing to find as many as four oils combined in the dressing. A dressing recommended to him consisted of Russian tallow, lard, or a substitute, seal oil, a little beef tallow, a pinch of resin and charcoal. Whatever oil is used as a base it would need a certain proportion of thickening matter. If the mixture was too thick the casting would have a peculiar wavy surface resembling a crocodile's skin. If still thicker, large black marks resembling thumb prints would be seen. If the mixture was too thin the casting freshly taken from the mould would be a bright golden colour in patches, and the surfaces of these patches would be honeycombed with small holes. The question of the influence of the oil base brought up another thorny subject, namely, mould temperature, as to which the practice of various works was widely divergent, the temperatures varying from 100 to 300 deg. C. If the mould was too hot, the surface of the casting was similar to that found when the dressing was too thin, and if the mould was too cold the surface of the casting showed dirty patches and was slightly corrugated. The use of lard-oil substitute or lard oil itself demanded a cool mould, certainly not above 150 deg. C. Seal oil and cottonseed oil also needed cool moulds, though a higher temperature might be attained if a little resin was added. Too much resin gave the casting a shiny, hard bluish surface, and the mould gradually became covered with a hard metallic skin. Personally he thought it better to use an oil base which gave the biggest latitude of mould temperature, and mineral oils of high flash point undoubtedly had this advantage. It had been suggested that oils of high viscosity at 150 deg. C. might be best for dressing purposes. But the ascertained viscosities of the common oils used in dressing showed that this property was not essential, otherwise castor oil with a viscosity of 390 deg. compared with the 100 of whale oil would make a wonderful dressing. The specific gravity also seemed to be a negligible factor, but either the flash point or the temperature of spontaneous ignition in oxygen did seem to give a fair indication of suitability for dressings. Tar and bitumen were quite good for dressings for heavy castings with a good body of metal, but their partial combustion left a good deal of dirt. Therefore, heavy mineral oils seemed to be as satisfactory as anything.

Internal Defects and Pouring Temperatures.

Internal defects in the tube wall were the most difficult to discover and to cure. At Muntz's Metal Company's Birmingham works great care was exercised to avoid faults of this nature. Every day sample castings were taken and burst by being expanded on plugs. The fractures were examined carefully. Another system used there was breaking up castings under a power hammer. He thought bursting by expansion was probably the best method, as fracture then occurred down the line of maximum defects. A tube so fractured often proved to be generally porous. Holes were seen all over the fractured surface, some dirty and some with a shiny internal surface. The only possible cause of such a bad defect was too low a pouring temperature. In 1920 Mr. Bamford and himself, in a Paper before the Institute of Metals, asserted that porosity of this type was found only in a tube cast below 1,150 deg. C. This statement was severely questioned on the ground that tubes cast a little above that temperature were usually burnt. Since that time he had seen many hundreds of tubes fractured, and he still did not understand the meaning of the expression "burnt tube." It was impossible to cast a brass tube much above 1,200 deg. C. owing to the rapid volatilisation of zinc. Since pyrometric control had been initiated at Muntz's this class of porosity had vanished entirely. It was a definite fact that high casting temperatures might give very slow cooling in a large billet, giving rise to large crystals and planes of weakness, but the annular space in which a tube was cast was too thin to allow of very slow cooling. Therefore, he was confident that brass tubes could not be spoiled by overheating within reason, although he was prepared to admit the advisability of casting billets at a slightly lower temperature. Another proof of the beneficial results of high pouring temperature was given by the mode of fracture of tube castings on the expanding plug. If the casting was sound but had been cast at a fairly low heat, the expander would rip the tube open in a straight line; but if the tube was correctly cast more power was required for fracture, which took place along a sinuous curve. It might be noted that if the metal was embrittled by any impurity, the expanding tool cracked small rectangular pieces from the casting, giving a tesselated effect.

Speed of Teeming and Slag Inclusions.

Another defect shown on fracture might be a slight porosity and general dirtiness of the tube walls. On examining closely many non-metallic inclusions could be seen. This class of defect was usually due to making the casting too thin for its length. Cutting down wall thickness to its limit to save drafts had been the cause of many toolmakers' troubles. If castings were made too long a similar defect was seen. A few black holes in the middle of the casting were usually a sign of too rapid pouring and the trapping of air in the mould. This was the cause of many

"spills" in the finished tubes. Too slow a pouring rate would cause intercrystalline cracking, usually accompanied by a corrugated surface. Slag inclusions and charcoal inclusions were due to imperfect skimming of the molten metal, the former usually had the shape of an inverted pear and might be black or pale green in colour.

Annealing Defects.

Defects of annealing fell under three heads, (1) insufficient annealing, (2) overheating, (3) fire cracking. The first two classes of defects, though obvious, must be referred to. In many tube works pyrometric control was unknown, and however experienced a man might be, he would not anneal all tubes perfectly. It was common practice for the mouth of the furnace to be shaded from the light so as to enable the man better to judge the temperature. The natural result of such crude methods was that tubes tended to be burnt in the bright days and under-annealed in the dull days. A good, red temperature was considered by many evidence that the tubes were annealed. If the coal was good and the furnace flame fierce the tubes quickly attained to this, but no time was allowed for re-crystallisation. Every annealing furnace should have its pyrometer and, if possible, a recorder, too. An under-annealed tube was dangerous in the tube mill; the fault could not be detected till the tube was on the draw-bench when it required more power. If the tube itself did not break off the mandril might part, and with worn machinery an accident might result. Overheating, of course, was more easily detected, as the annealed tube then usually showed a yellowy green bloom due to oxide of zinc. Such samples were sometimes so full of intercrystalline cavities that they broke when dropped on the floor. Their fracture sometimes showed very coarse acicular crystals. Such tubes seldom stood up to the test of the draw-bench. Local overheating sometimes caused a weak area in otherwise good tubes. It was in detecting underheating and overheating that the microscope was most generally useful in a tube works. Sections at right angles to the direction of drawing were usually the most instructive.

Drawing Defects.

With regard to defects of drawing, he would pass over mere mechanical details affecting the appearance or gauge of the tubes and would refer chiefly to the effect of drawing on the stability of the finished tube. Such a discussion centred about the production and distribution of stresses in the tube. There were really only two methods used in drawing a tube; one, known as "hollow sinking," was for reduction of diameter without reducing the wall thickness, though it might result in a slight thickening of the walls or a very slight reduction according to circumstances. Reduction in internal diameter was known as sink. The other process, the reduction of wall thickness, was accomplished by supporting the tube inside with a bar or plug. Such reduction he would call "pinch." Of course, the usual "draft" was a combination of these two methods. In a Paper by Mr. R. H. M. Vawdreg and himself, read before the Faraday Society, he described the results of some experiments on 70:30 brass tubes. A tube which had been "hollow sunk" was well known to be liable to fire-cracking and season-cracking, and therefore must be in a state of internal stress. A tube was made from a well-annealed sample 1¾ in. × 1½ in. by drawing through a die 1-29-64ths bore. This corresponded to a sink of approximately 9/32nds in. The tube after drawing was perfectly straight, but after lying on the laboratory table for four days the piece, 3 ft. 6 in. long, had deformed ¼ in. from the straight. This was evidently due to longitudinal stress. But great though the stress must have been, it was small compared with the transverse stresses because the rupture of such tubes always occurred in a direction parallel to the longitudinal axis. Another curious phenomenon in connection with hollow-drawn tubes or any tubes having high internal stresses was their behaviour when treated with mercurous nitrate solution in various ways. The intensity of internal stresses could be roughly gauged by the time taken for cracks to develop when the stressed article was placed in such a solution. When the outside of a highly stressed tube was treated with the solution, cracks developed as quickly as if the tube were immersed completely. If the inside were so treated, cracks might not develop for several days. A tube that had been made by a reduction by pinch alone would not crack at all in such a solution; it would not fire-crack or season-crack, however much there had been put upon it. Tubes which had been subjected to pinch and sink might or might not crack, according to which effect predominated.

Obviously if in a tube mill it was the practice to sink tubes, season cracking would occur in the mill stock and fire cracking in the annealing furnaces. A defect more difficult to explain was stratification or lamination. It was primarily suggested that the cause of this failure lay in the casting department, but after much careful experiment it was definitely proved that this assumption was not tenable. A series of experiments was conducted to see whether it was possible that laminations could be caused by drawing. The explanation could not be given definitely, but it appeared probable that in the wall of a hollow sunk tube the circumferential stresses were concentrated near the surface. It was found that removal of both the skins tended to give a tube of greater stability, whereas the removal of the inside layer only tended to disturb the equilibrium. The difference of behaviour of the inner and outer skins was accounted for by the resistance offered by a hollow circular solid to any reduction in internal diameter. An examination of the microstructure also supported the theory. Experiment disposed of an alternative suggestion that the skin at the outer edge was really acting as a support and not as a highly stressed area. The conclusion was that the correct method of drafting was to combine pinch and sink. So well did these suppositions fit in with practice that, having worked out a system of balance for the drafts of all tubes manufactured, they had been able to make bad tubes to order with a remarkable degree of success.

Having given an account of a suggested method of differing potential in the study of the drafting of tubes, Mr. Ballard dealt with the final methods of testing tubes in the works. The roughest method, but the one generally used, was the sighting bench, the tubes being examined by looking down them on to an illuminated white plate. Another standard method was by means of the hydraulic pump. Under an internal pressure of from 1,000 to 1,200 lb. per sq. in. any small porosity or hole in the tube wall would burst. This test was used especially for condenser tubes. In the bulging test, by means of conical plugs a fair average was to say that the ends of the tubes must stand bulging to 25 per cent. increase of diameter. A further modification of this test was the flange.

The much-discussed low temperature annealing had been recommended with a view to prevention of season cracks and as an aid in the prevention of corrosion. Its usefulness for the latter purpose the author was not at present prepared to discuss, but to his mind it was an uneconomic method of preventing season cracking.

Miguet Process for obtaining Alumina from Clay.—A good grade of clay contains from 30 to 40 per cent. of alumina, and M. Paul Miguet, in the U.S. patent granted to him, proposes to prepare an alkaline aluminate by fusing clay, lime and scrap iron with a reducing agent in the electric furnace. The sodium aluminate thus obtained readily yields aluminium hydroxide while the ferro-silicon should be a profitable by-product. So many reactions similar to the above have been proposed, and it is so popularly believed that alumina can be obtained from clay by fusion that the U.S. Bureau of Mines undertook to investigate the process. The results are recorded in "Reports of Investigations," Serial 2,393, by Messrs. Clyde E. Williams and Clarence E. Simms. Analysis showed that 40 per cent. of the silicon had been reduced and alloyed with the iron. About 30 per cent. of the alumina was recovered. However, the prospects of a successful commercial application are extremely poor, as under the most favourable test the cost of material alone would be more than $300 per ton. Moreover, there is no proof that calcium aluminate was formed.

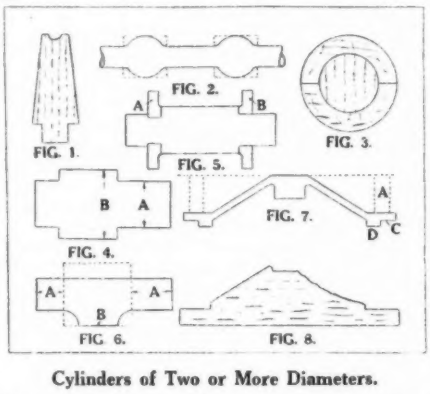
An Apprenticeship Course in Foundry Practice.—XIX.

By Ben Shaw and James Edgar.

LATHE WORK.

In some patternshops jobs of small diameter and of great length are common. It is necessary to turn them at fast speed, and yet, when the lathe is run at a fast speed, the vibration is excessive. If the diameter varies in such work, the largest diameter should be turned first—after the preliminary roughing-down—but the first operation should really be to turn a short distance in the centre to support a "steady." The steady may consist of a thick block of wood cut at the bandsaw to fit into the lathe bed and gouged at the top end to allow the work to turn in it (Fig. 1), or it may be a more elaborate device with a cover. The diameter which runs in the improvised bearing must not be a finished diameter, and it is usually necessary to finish with the plane at the bench. A very common job of this kind in ship patternshops are deck rails and stanchions (Fig. 2). In turning such a job the large bulb diameters would be turned first, centres carefully marked, the small diameters then turned, after which a template would be used to finish off, the ends of the template, which would have a centre line to correspond with those on the job, resting on the small diameter.

Wooden centre plates should be fixed on cylindrical work, so that the grain will run as shown at Fig. 3. This reduces the danger of the plate splitting on the joint line of the pattern. For either wooden or iron plates thick screws should be used, and they should have at least a grip of 1 in.



Cylinders of Two or More Diameters.

When turning cylindrical work of small size from solid timber, it is customary to get the rough block out to the largest size and turn down, but this would be wasteful in the case of lagged barrels. Not only would it be wasteful of timber, but it would cause the work to be much heavier, when first placed between the centres, than is necessary. Let us suppose that a barrel has to be made 12 in. dia. at A (Fig. 4) and 15 in. at B. If the staves are planed concave and convex, and fitted on circular grounds, it is quite a practical job to build the staves for the large diameter before the work goes into the lathe, but, in most pattern-shops, barrels that are going to be turned are not built in this way, and, in some cases, it may be a real advantage to turn the smaller diameter first and fit the top staves on in the lathe. Usually, however, as in the first-mentioned case, it is quicker to do all the building before starting to turn; it is a question that must be answered according to circumstances and according to the machine equipment of the shop.

Another point which may be worth mentioning here is the fitting of flanges and leaving unturned parts of a cylinder body to which branches have to be fitted. Unless, when there is a probability of alterations, a much superior job is made by setting flanges in, as shown in Fig. 5 at A. When they are fitted on the print diameter, as at B, they are very easily moved out of position; indeed, if the flange warps, it becomes locked in the mould. Some patternmakers turn flanges on a faceplate, but a better result is obtained by turning them on the cylinder body, which should be left slightly larger than the required diameter until the flange has been fitted.

At Fig. 6 is shown a cylinder to which a branch has to be fitted which is joined to the main body by a fillet. Considerable skill is required to make a satisfactory job in a reasonable time. Some men would very carefully centre-line the block and plane the face (B) square with the joint, and trust to accurate setting of the centre plates. It is better, however, to leave the centre portion balanced, as indicated by the dotted lines, and especially so if the job is long. In any case, the face should not be finished until the work has been taken back to the bench. The tendency of the times is to eliminate carved fillets wherever possible, substituting plastic-wood, leather, or wax fillets, but there can be no gainsaying the fact that, for branch work such as we have been considering, the carved fillet is much superior.

Using the Hollow Mandrel.

For turning special dowels and other small jobs the hollow mandrel makes a very good chuck. There are small parts which are too small to be turned with safety between the centres, but sometimes a piece of tapered timber can be forced into the hollow mandrel and the work turned at the necessary high speed. If it is long, the cone centre may be moved up to steady it. Another means of chucking is by means of a centre-screw in a small iron faceplate; this is very useful for turning small bosses. The paper-joint for very thin, delicate work is quite safe and satisfactory, but it is not as convenient as screws or sprigs.

Face Plates.

As a part of the equipment of every lathe there should be an assortment of wooden faceplates. In the use of faceplates much waste occurs. When reversing work, a faceplate will be frequently spoilt by turning deep recesses from its face, when a few small segments on the face to take a projecting spigot or boss would serve the purpose equally as well. Faceplates up to 12 in. dia. should be made from solid timber about 1 in. to 1½ in. thick. Above this size they should either be in two thicknesses, crossed or well battened on the back. If the faceplate is not quite rigid, the most highly skilled turner cannot turn out good work.

We shall suppose that a valve cover similar to Fig. 7 has to be turned. It is invariably advisable to turn the inside of a faceplate job of this kind first, because there will be more "spring"—it is not exactly vibration—when the timber is reduced in thickness, and there is great possibility of the tool tearing the work on the inside than on the outside, because one has less control over it. After the faceplate has been skimmed—it is necessary to straighten wooden faceplates very frequently—blocks must be screwed to it of a parallel thickness. It should not be necessary to turn these blocks on the face, as the inside is being turned first, but it would be necessary to do so if the outside had been turned first. The blocks should be curved, and may be three or four in number. They are indicated by the dotted lines at A (Fig. 7). When they have been screwed to the faceplate, the rough pattern may be screwed to them from the face.

The proper template for such a job is shown at Fig. 8. A full template is not advisable, because, with the greatest care, there will be slight discrepancies between the two sides; further, if the template is applied when the lathe is running, it may be broken. It will be noted that the faces A, B and C are turned without the template. This is a pattern that can be completely built before turning is commenced, but, in many cases, owing to the great depth, it might be difficult to get a rest close to the work, and it would be better to build part of the pattern, turn this, then complete the building, when the remainder could be turned.

Reversing is necessary with the valve-cover pattern, and segments can be sprigged or screwed to the faceplate and turned on the face and inner diameter to take the spigot on the cover, which can then be screwed from the back of the faceplate. A half-template would again be used, and either the centre used as a guide or the outer periphery of the cover, which would have been turned before the pattern was reversed.

Use of Turning Tools.

We shall consider briefly the actual use of woodturning tools now, but it can be stated at once that, when a few elementary principles have been mastered, only experience will develop skill. The apprentice is advised to seek opportunities for acquiring skill. An essential difference between pattern turning and ornamental turning is that, for the former class of work, scraping tools are frequently employed, while in the latter class of work cutting tools are used. Sometimes the reason for scraping tools being used by patternmakers is attributed to their lack of skill as turners. This is not a satisfactory reason, however. The gouge and the skew chisel are not used as much as they might be, but for much pattern work scraping tools are undoubtedly the most satisfactory. There may not be general agreement on this point, but it will be approved by many men who have had a wide and varied practical experience.

In turning cylindrical work, the gouge could be used much more than it is. The T rest should be brought as close to the work as is possible, and when it has been roughed to a diameter, the rest should be again moved in. As to the correct height of the rest, if scraping tools are being used, it should be set so that the edge of the tool will be in contact with the centre of the work or very little above it, but, when the gouge is used, the rest should be above the centre of the work, an amount depending upon the diameter of the work being turned, in order that the angle of the gouge to the work will be less acute and the bearance on the rest as close to the end of the tool as possible. The gouge should be held so that its cutting edge is at a tangent to the revolving wood, and the cut applied by raising the back hand holding the handle of the tool. To finish off, the cutting chisel should be used, if the work is straight and not more than about 6 in. dia. It is, of course, also useful for shaped work, providing the shape varies gradually. The cutting chisel is the most difficult woodturning tool to use, and a few minutes' instruction from a practical hand will teach the apprentice more than much written directions. This tool is bevelled on both sides for use in cutting either to the right or to the left, whichever is desirable for the work being turned. This tool should be held at an angle to the wood, and in such a manner that it is at a tangent to it. It is necessary to hold it an an angle to free both corners of the tool and to give support on the rest directly opposite to that part of the tool which is cutting. Careless use of this tool is likely to end disastrously, because, if the point is allowed to catch the revolving work, it will tear it and probably pull it from between the centres.

The scraping tools that the patternmaker uses are square chisels, left- and right-hand skew chisels, round noses and diamond points, the latter being a double-skew tool with the cutting edges at less than right-angles to each other. As a rule, scraping tools are ground on one side only, and they should be ground at a less acute angle than is necessary for bench tools, because greater strength is needed. The writers are of the opinion that in all cases where a template is used the turning should be done with scraping tools, particularly faceplate work. Large cylindrical bodies turned between centres can be turned very satisfactorily by means of a small thumb plane. It can be set at an angle in the same manner as a cutting chisel, with the sole of the plane on the rest.

In nearly all pattern turning the whole job should be rough-turned before any part of it is finished. This eliminates vibration due to want of balance, and ensures greater accuracy. It should be remembered that it is safest to stop the lathe to adjust the rest and to use callipers.

The New Parliament.

Some Representatives of the Iron and Steel Trades.

From the number of members representing the industries of the country the new Parliament promises to be an exceptionally interesting one. In fact, it is necessary to go back as far as 1910 to find such a large number of candidates, either directly or indirectly, associated with the coal, iron, steel, engineering and allied industries. Although many have not been successful, the aggregate is still formidable, and we append brief details of the more prominent features of the careers of some of the new members to be elected :—

Barrow-in-Furness.—Mr. D. G. Somerville is head of the engineering and construction firm of D. G. Somerville and Company, Limited, of London, and is connected with a group of other engineering firms in this country and on the continent which carried out contracts for various Governments during and since the war. Mr. Somerville is a Scotsman, and served his time as an engineer.

Croydon—South.—Sir Allan M. Smith is chairman of the Engineering and National Employers' Federations and of the Employers' Section of the Joint Committee of the Industrial Conference. He was knighted in 1918.

Darlington.—The Rt. Hon. H. Pike Pease, who is a member of the well-known Pease family, is the second son of the late Mr. Arthur Pease, and was Assistant Postmaster-General in the late Government from 1915. He is a director of the Normanby Iron Works Company, Limited, Pease and Partners, Limited, Henry Stobart and Company, Limited, and the North Bitchham Coal Company, Limited.

Dudley.—Mr. C. E. Lloyd is very closely associated with the iron industry as chairman of N. Hingley & Sons, Limited, one of the few remaining marked bar houses. He is, of course, a member of the Birmingham Exchange and attends most Thursday markets. He is also a director of Lloyds British Testing Company, Limited.

Gorton.—Mr. J. Hodge (Lab.), originally a steel worker, is now president of the Iron and Steel Trades Confederation. He was Minister of Labour in 1917 and afterwards Minister of Pensions, 1917-1919.

Greenwich.—Mr. G H. Hume is a member of the Institution of Electrical Engineers.

Hammersmith—South.—The Rt. Hon. Sir William Bull, Bart., is chairman of J. W. Singer & Sons, Limited, iron and bronze founders, Frome, and a director of Siemens Bros. & Company, Limited, and Siemens Bros. Dynamo Works, Limited.

Hampstead.—Mr. George Balfour is an engineer, the founder and head of the firm of Balfour, Beatty & Company, Limited, and a director of several other undertakings, including the Scottish Power Company, Limited, Midland Counties Electric Supply Company, Limited, and the Lancashire Electric Light and Power Company, Limited.

Kingston-upon-Thames.—Mr. F. G. Penny was appointed some years ago general manager of the Eastern Smelting Company, Limited, and is now one of the London directors.

Middlesbrough—East.—Mr. John Wesley Brown is chairman of Hanson, Brown & Company, Limited, iron, steel, coal and ore merchants, of Queen's Square, Middlesbrough, with branches at Liverpool and Newcastle-on-Tyne. The company are agents for Bayliss, Jones & Bayliss, Limited, F. Dupre, Electro Metals, Limited, Eyre Smelting Company, Limited, and the Middlesbrough Fireclay Works.

Sheffield—Park.—Lieut.-Col. H. K. Stephenson is chairman of Thomas Turton & Sons, Limited, steel and file manufacturers, etc., Sheffield, and Stephenson, Blake & Company, Limited, typefounders. He has been Lord Mayor and Master Cutler of Sheffield.

Swansea—West.—The Rt. Hon. Sir Alfred Mond was First Commissioner of Works from 1916 to 1921. He then became Minister of Health on the resignation of that office by Dr. Addison. He was formerly associated with Brunner, Mond and Company, Limited, and the Mond Nickel Company.

The board of Henry Bessemer & Company, Limited, has been completely changed. Mr. A. G. Longden, Lieut.-Colonel Cecil Allen, and Mr. W. Wostenholme have retired, and a new board has been appointed. The new chairman and managing director is Sir Walter Preston, who is a director of J. Stone & Company, Limited, of Deptford. Mr. A. W. Rippon, of St. George Street, Westminster, who has been associated with Sir Walter Preston for some years, is to be the new commercial managing director, and will reside in Sheffield, and a third appointment to the board is Mr. R. Hargreaves, of Sheffield.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Hestia Core Stove.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—With regard to "A Foreman Moulder's" inquiry in your last week's issue regarding the "Hestia" core stove, I can assure him that the makers have had ample experience in the drying of barrel cores, and that the results were very satisfactory. The design of the "Hestia" is such that it extracts all moisture without burning or scorching the face or foundation of the core, and thus leaves the core in the strongest possible condition.

As regards attention, the stove is charged with fuel about 5 p.m. and it is not touched from then until 8 a.m. the next morning. The fire can then be replenished or allowed to die out according to requirements. A steady temperature is maintained throughout the night.

Yours, etc.,

J. M. LOCKHART.

46a, Market Street, Manchester.
November 20.

Manufacture of Locomotive Cylinders.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—It is gratifying to learn that there are so many foundrymen anxious to know a little bit more of the method used at the G.E.R. Works, Stratford. In response to "Foundryman's" query about openness of structure, apparently due to the Si. being as high as 2.02 per cent., it is readily admitted that it is too high to conform to up-to-date practice, since Si. itself does determine the amount of graphitic carbon present and this controls the supposed openness of character of the iron. In conjunction with the other elements present, however, this property is to some extent modified, especially with the high sulphur content (0.125 per cent.) present. At the same time, in my opinion, the Si. is too high, as is also the P., but bearing in mind phosphorous hardens iron and that 0.125 sulphur is present, the conditions necessitate a higher Si. content than one would expect to use in the manufacture of castings of this class. With reference to the utilisation of a higher Mn. content, I again agree that with P. lower we could increase our Mn. to advantage, but under prevailing conditions I suggest that we do not want any more of the elements present which tend to harden the casting. It is admitted that Mn. softens iron to the extent with which it reacts with the S. Thus, summarising the effects of the different elements in the G.E.R. cylinder mixture, silicon is not too high in comparison with the amount of phosphorus, as the phosphorus content allowed before the limit of safety is reached is given as 0.7 per cent. Thus even here it is seen that we are working close to the danger line with the phosphorus. The evil effect of this element, that is the liquation, which takes place during cooling, is overcome by having the casting of uniform thicknesses. The sulphur content tends to close up the structures, whilst the Mn. 0.50 per cent. is quite sufficient to ensure soundness from blow-holes due to occluded gases. "Foundryman" suggested that the amount of charge (8 cwts.) was too small. If he refers to economy, I disagree, because this is determined by the fuel ratio, and in this case our proportion of coke to iron is 1 to 9. Bearing in mind that we use 50 per cent. of cold-blast and hematite pig-iron in the charges, and also that our iron is always brought down very hot, I claim this ratio to be satisfactory. Incidentally, if we charged 1 ton at a time, as suggested, this, I am sure, would raise the coke bed, which would introduce a tendency to "imperfect" combustion. The "Roots" blowers question is simply due to a typographical error, as we only use one at a time. The methods of moulding are not expensive, inasmuch that primarily our loam mixture is cheaper than our strong sand or "fat" mixture, and secondly the moulders are on piece-work, and find that less mending to the moulds is required when using our loam. The "sane inspection" of castings existing at the Stratford Works is merely due to the cordial co-operation of all concerned. It can truthfully be stated that the super-heater class of cylinders, under consideration, have not, up to now, as far as I know, had any blemish or faulty places.

Finally, sir, with reference to our mixture not being superficially satisfactory, may I submit an analysis of a mixture for hydraulic castings taken from McWilliam and Longmuir's text book on foundry practice, and for comparison repeat my own:—

	Si.	Mn.	S.	P.
McWilliam and Longmuir..	1.85	0.65	0.06	0.88
G. E. R. Cyl. Mixture ..	2.02	0.50	0.125	0.77

Yours, etc.,

A. F. GIBBS.

Gazette.

CASTINGS (CONGLETON), LIMITED.—Mr. R. E. Clark, 17, Albion Street, Hanley, has been appointed receiver.

STERLING GENERAL ENGINEERING & MOTOR COMPANY, LIMITED, Westgate-on-Sea.—Mr. T. W. Ramsey has ceased to act as receiver.

ESSEX ENGINEERING & MACHINERY COMPANY, LIMITED, London, W.C.—Mr. F. J. B. Gardner ceased to act as receiver, November 3.

MR. E. R. VERNON, trading as E. Vernon, jun., 16 and 18, Colmore Street, Birmingham, machinery dealer, has been adjudicated bankrupt.

BRADLEY STEEL STRIP COMPANY, LIMITED.—It has been resolved:—That the company be wound up voluntarily. Mr. J. Gough, 267, Castle Street, Dudley, has been appointed liquidator.

MESSRS. J. FAIRBAIRN & COMPANY, Kinningpark Brass Foundry, Vermont Street, Kinningpark, Glasgow, have dissolved partnership, by retirement of Mr. J. P. Fairbairn. Debts by Mr. R. Fairbairn, who continues the business.

Death.

MR. J. B. HUMPHREYS, director and manager of Ferguson Superheaters, Limited, 20, Kingsway, W.C.2, with whom he had been associated for many years, has died as the result of a motor-car accident.

Personal.

MR. WILLIAM DONALD has resigned his directorship of the Eglinton Magnesite Brick Company, Limited.

THE LATE Mr. J. Keeling, for more than forty years works manager to Charles Akvill & Company, iron-founders, West Bromwich, left £4,381.

MR. C. W. D. TOWNSEND, general manager of the Scunthorpe works of John Brown & Company, Limited, has been elected a local director of the company.

DR. J. F. CROWLEY, on severing his connection with the English Electric Company, Limited, was the recipient of a presentation from his friends and colleagues.

MR. JAMES DICKINSON has been appointed as a lecturer in Electrical Engineering at the Armstrong College, Newcastle, in place of Mr. J. A. Harle, who has received an appointment with a Tyneside firm.

DR. G. B. WATERHOUSE, an ex-Sheffield University metallurgical student, has been appointed Professor of Metallurgy at Massachusetts Institute of Technology. Since 1908 he has been technical director of the Lackawanna Steel Company, Buffalo, U.S.A.

MR. FRANCIS WILLIAM GILBERTSON, J.P., of the Mumbles, and Sir Aubrey Brocklebank, of Sandiway, Cheshire, have been elected as directors of the G.W.R. Company to fill vacancies caused by the resignations of Sir John T. D. Llewelyn and Mr. Ernest H. Cunard. Mr. F. W. Gilbertson is a member of the council of the Federation of British Industries, and a director of the Slag Phosphate Company, Limited, and of W. Gilbertson & Company, Limited.

Trade Talk.

HENRY BRICE AND COMPANY, engineers, have removed from Thornton Heath to 37, Jewry Street, London, E.C.3.

THE BRITISH L.M. ERICSSON MANUFACTURING COMPANY now have their offices at International Buildings, 67/73, Kingsway, London, W.C.2.

COOK & NICHOLSON, LIMITED, and the Fredk. Crane Chemical Company, Limited, have been elected members of the Federation of British Industries.

I. HOOD & COMPANY, LIMITED, 7, St. Stephen's Avenue, Bristol, have been appointed agents in the West of England for Brook, Hirst & Company, Limited, Northgate Works, Chester.

THE CLEVELAND BRIDGE & ENGINEERING COMPANY, LIMITED, have secured the contract for the steelwork for the widening of the Great Northern Railway from Fletton Junction to Peterborough.

THE SHEFFIELD FILE TRADE TECHNICAL SOCIETY discussed file testing on November 9, when a paper was read by Mr. H. G. Smith in the Mappin Hall of the Applied Science Department. Mr. J. L. Howard presided.

A MEETING of the Scottish Centre of the Institution of Electrical Engineers was held last week in Glasgow. Mr. A. S. Hampton, president, delivered his inaugural address, which dealt with the economic aspect of railway electrification.

G. & J. WEIR, LIMITED, Cathcart, Glasgow, have made arrangements with Messrs. Sulzer Frères, Winterthur, to build the new type of Diesel engine recently developed by the Swiss firm, and to apply it to marine auxiliary purposes.

DONOVAN & COMPANY, electrical manufacturers and suppliers, 47, Cornwall Street, Birmingham, have appointed Mr. David Alexander, of 43, Mains Street, Waterloo Street, Glasgow, as their agent in Scotland for Ironclad switch and fuse gear.

AT a meeting of the Glasgow and West of Scotland Foremen Engineers and Draughtsmen's Society, held on November 11, Mr. Thomas Taylor presiding Professor A. L. Mellanby delivered a lecture on "Some Steam Turbine Problems."

A DESTRUCTIVE fire broke out on November 11 in the works of Reid, Macfarlane & Company, Limited, Maxwell Road, Shieldhall, Govan. The outbreak originated in the store at the east end of the main shop, and considerable damage was done.

A FUSION has been effected between the firms of T. Cooke & Sons, Limited, of London, York, and Cape Town, and Troughton & Simms, Limited, of London and Charlton, and in future business will be conducted under the name of Cooke, Troughton & Simms, Limited.

MR. D. S. PAXTON, district representative for Brown, Boveri & Company, Limited, Power-Rectifiers, Limited, the Visco Engineering Company, Limited, Electromobile, Limited, Snow & Company, Limited, has removed to Campfield Chambers, 312, Deansgate, Manchester.

MR. A. J. G. SMOUT, the president of the Birmingham Metallurgical Society, recently visited the Wolverhampton branch at a meeting held in the Technical School, and delivered the opening lecture, of the session on the subject of "Fuel Economy in the Metal Industry."

A MEETING of the Birmingham Metallurgical Society was held at the Chamber of Commerce on November 9, when Professor R. P. Haigh, of Greenwich Naval College, delivered a lecture on the elastic and fatigue limits in metals. The president of the society, Mr. A. J. G. Smout, was in the chair.

THREE vessels of 14,900 total net tons were launched on the Tyne in October, compared with seven vessels and 28,923 tons in the corresponding month of last year. From January 1 to October 31 there were launched 32 vessels of 119,189 tons, as compared with 55 vessels and 171,061 tons in the corresponding period of last year.

THE TYNE COMMISSION has accepted the tender of Palmers Shipbuilding & Iron Company, Limited, for the construction of four single-screw steel hopper barges, each of 800 tons capacity, subject to the hulls of the vessels being built on the Tyne. The agreed price is £76,000, the first craft to be delivered in six months' time.

THE MONTHLY ASCERTAINMENT shows that the average selling price of West Coast Bessemer mixed numbers during October, 1922, was £4 10s. 4d. per ton, an advance of 11d. on the previous month, and the wages of blastfurnacemen in Cumberland and North Lancashire are accordingly increased by ½ per cent. to 30½ per cent. above the standard.

MELDRUMS, LIMITED, Timperley, near Manchester, have, during the last two months, taken 13 orders for forced draught furnaces and mechanical stokers, including chemical works, gasworks, engineering works, and collieries (one a repeat for 18 boilers to be fitted, making 23 in all this year). Orders for destructor furnaces number six, including chemical works and two railways.

A MEETING of the Joint Board in connection with the South Wales steel industry was held at Swansea on November 10, for the purpose of considering an application from the men for the renewal of the *ex gratia* bonus for another three months and the consideration of other claims. Mr. F. W. Gilbertson presided. The employers agreed to extend the *ex gratia* bonus for another three months, but in regard to applications for an increase in the base rates of the lower-paid men and the abolition of the putting of gas into furnaces in certain works on Sundays, they expressed regret at inability to accede.

AT the last meeting of the Diesel Engine Users' Association Mr. G. E. Windeler read a paper on the "Care and Maintenance of Diesel Engines," in the course of which he referred to the action which had been taken by the Association in collecting information with regard to Diesel engine working costs. Apart from the advantage which members were likely to gain individually from the collection of such data annually, it seemed to him only proper that the Association should at the earliest possible moment put itself into the position of being able to supply definite average figures of working costs based upon actual results obtained in the operation of representative Diesel engine installations.

JORDANS, LIMITED, and Thomas Spittle, Limited, have decided to accept the offer of the Newport Corporation with respect to the Talybont pipe line contracts. These firms withdrew their tenders to supply pipe lines owing to conditions imposed by the Corporation. In view of the large amount of unemployment in the town, there was a strong feeling that the contracts, amounting to £101,960, should be let to local firms, and the Corporation decided to ask Messrs. Spittle and Messrs. Jordans whether they would agree to accept the contract on the same terms as it had been provisionally let to Cochrane & Company, Limited, Middlesbrough. We understand that the Newport firms mentioned have now agreed to do so.

THE NATIONAL COMMITTEE OF THE AMALGAMATED ENGINEERING UNION have circulated in their branches a manifesto setting out the total expenditure from July, 1920 (when the eight engineering unions were amalgamated), until June of this year. The total amount paid out, according to the rules, during the period under review was £4,056,458. Of this amount £2,672,306 went in unemployment benefit, and £800,000 in sickness and superannuation. In addition £577,256 was paid out as the result of special levies. The total cost of administration amounted to £522,307, equal to 2s. 6½d. in the £. Members are urged to realise the seriousness of the position, and are informed that it is wholly due to the heavy drain on the funds because of unemployment that certain benefits have since been stopped.

A Substitute for Small Forgings.—In a recent issue of "The Iron Age" Mr. Larry J. Barton describes the manufacture in an electric furnace of alloy steel castings to be heat-treated and used as a substitute for forgings, and for purposes where the ordinary grades of steel castings are unsuitable. The author remarks that there are many cases in mining and other work where a superior product is desired, and quite often the shape is such as to make forging very difficult, if not impossible. For this work it has been found that a properly made and properly heat-treated alloy-steel casting furnishes a suitable material. Not only can certain conditions be met, but by changing the treatment the same metal can be used for several different purposes. This results in being able to send out several castings, all of the same chemical composition which, when treated according to the directions sent with them, will cover widely differing specifications. Steels containing chromium, nickel and vanadium offered the most feasible and versatile products for the different classes of work covered. Some castings contain only nickel, some only chromium, some varying combinations of nickel and chromium, and some consist of different amounts of all three elements. Carbon content is adjusted to meet the varying conditions. The author recognises the difficulties in obtaining a uniform product, and remarks that often castings poured from the same heat and treated in the same manner will show widely differing results, and explains this by a difference in structure caused by different pouring temperatures, different texture and temperature of the mould, etc.

IRON AND STEEL MARKETS.

Pig-iron.

Conditions in the pig-iron industry remain much the same as reported during the past few weeks, and although it is now too late to hope for any important developments during the concluding period of the year, it is confidently assumed in trade circles that the change of Government resulting from the election just finished will ensure something nearer stability than has been experienced over the last four years. In the Midlands, prices of pig-iron continue remarkably firm, while reports indicate that demand for ordinary forge quality is maintained, and that some of the heavy foundries are rather better customers than they were earlier in the year. This improvement, however, is relatively slight, and the furnaces already in blast are able to cope with it quite satisfactorily. There is not sufficient volume of demand to tempt owners to blow in additional furnaces, nor is there anything in the price obtainable to induce them to do so. The Scottish pig-iron market is reported slightly easier, with a tendency on the part of makers to shade prices with a view to attracting buyers. With the falling away of the American demand there is no compensating inquiry or orders coming from other directions, and probably some of the works are now stocking iron in their yards. If these conditions continue, it is not unlikely that we may see the blowing-out of furnaces, and as there are only 29 on foundry, and three on hematite in operation in Scotland, the suggestion that the production will require to be diminished, shows that the iron and steel trade of the district is still in a very poor state. At Sheffield buying shows a more active tendency, the qualities most favoured being basic and foundry, while the demand for hematite implies some improvement in steel-trade conditions. The Cleveland iron market remains quiet as concerns home demands, while further weakening in the Continental exchanges is by no means favourable to the prospects of the export trade of Tees-side. Confirmation of this fact is found in the shipments return for Tees-side so far this month, showing that up till and including the 14th inst. the total is only 21,809 tons, as compared with 31,503 tons in the corresponding period of last month. The decrease is, of course, explained by the falling-off in the Transatlantic trade for the time being, but it by no means follows that buying on American account has finally ceased. It must still be remembered that Cleveland iron is several dollars below American prices, and while this state of affairs obtains business will continue. But buyers are cautious, and inquiries to hand during the last few days appear to be for prompt cargoes. For foundry iron to special analysis there is, however, still quite a brisk demand, and contracts are being made for delivery over the first quarter of next year at about 97s. 6d. per ton. The following are current quotations, f.o.b. and f.o.t.:—No. 1 and silicious, 97s. 6d.; No. 3 G.M.B., 92s. 6d.; No. 4 foundry, 90s.; No. 4 forge, 85s., while mottled and white, which are nominally 82s. 6d., could probably be done at from 80s. to 81s. 6d. per ton.

Hematite is certainly the strongest feature in the pig-iron market at the present time. Demand is well maintained, and several makers are fully sold till the end of the year. The inquiry from America also continues, and new business is reported during the past week, including substantial quantities for delivery early in the new year. Quotations are firmly held, 93s. being a minimum figure for East Coast mixed numbers, with the No. 1 quality at a premium of 6d. to 1s. per ton. West Cumberland and North Lancashire qualities of hematite are also a strong market, buying being heavier, not only on export, but also on home account, and users are extending their commitments well into January. In short, a greater stride forward has been taken of late than it has been possible to record for eighteen months past. A natural result of course is the relighting of additional furnaces. The ordinary iron is going to America and to the Continent in 1,000-ton lots, and to Scotland and South Wales. Prices are firm, Bessemer mixed numbers being quoted at £5 10s. per ton delivered at Glasgow and Sheffield. Consumers in the Midlands are taking the greater part of the make of low phosphorus iron, and prices vary according to analysis.

Finished Iron.

Business in most sections of the finished iron industry continues in a languid condition, only a small percentage of works providing regular employment, chiefly confined to manufacturers with fairly substantial contracts in course of execution. A general complaint in the trade at present is an abnormal hesitation on the part of consumers in placing forward business, most buyers confining transactions to more immediate requirements, which, at the moment, comprise orders on almost a retail scale, giving only temporary relief from total unemployment. Notwithstanding these somewhat gloomy conditions there is now in evidence a much more hopeful feeling that the worst is passed, and manufacturers look forward to the coming year to redress the stagnation so long prevailing in the trade. In South Staffordshire makers of the commoner qualities of bar iron are feeling the full intensity of Belgian competition. For instance, Belgian No. 3 bars have been offered at £7 10s. delivered Birmingham. The quotation for the corresponding quality made in the district is £9 15s., and it may seem an extraordinary anomaly that this price has been obtained notwithstanding the tremendous advantage which, on the surface, appears to rest with the foreigner. The Midland quotation is, however, fairly firm, but if sellers are urgently in want of orders, or if specifications are particularly attractive, concessions are obtainable. There is still only a quiet trade in crown and marked bars, and no doubt it will remain so until such time as the cost of production is lowered and makers are able to sell profitably at a price more in keeping with the prevailing general commercial conditions. The iron-strip trade shows no improvement.

Scrap.

Reports from most of the scrap metal markets indicate awakening activity of demand for certain qualities of material, but, on the whole, the general position of the trade leaves much to be desired in the scanty volume of business open at the moment. In the Midlands the improved demand for heavy steel scrap recently reported has been maintained, and prices are considerably firmer. The same remark also applies to heavy steel turnings, although, in this instance the price is not quite so firm, and supplies are very difficult to obtain. Heavy wrought-iron scrap is in good demand, but prices, up to the moment, have not shown any signs of improving. The demand for cast-iron scrap is relatively small, and prices offered, taking into consideration the intrinsic value of the material, are low. On Tees-side the scrap market just now is rather quiet, and except for heavy steel scrap there is no considerable volume of business passing. For heavy steel there is still a good demand, with the price held round about 68s. per ton, delivered works. Other quotations, all delivered works, are as follows: Heavy steel turnings, 54s.; cast-iron borings, 52s. 6d.; heavy cast-iron machinery scrap in handy pieces, 75s. to 77s. 6d.; heavy wrought-iron bushelling scrap, 55s. to 57s. 6d.; ordinary heavy piling, 60s.; specially selected heavy forge 70s. to 75s. per ton.

Steel.

Gradual improvement is again noticeable in various branches of the steel trade, and although progress is necessarily slow, the prospect of further development is apparently assured early in the new year. At Sheffield buying movements in series are increasing satisfactorily, orders coming forward for basic billets with comparative freedom, both on home and export account. There are also inquiries for acid qualities of billets, though only in a small way at present, and an improvement is noted in alloy steels. Railway and motor steels are decidedly better. Within the past week or so further steel furnaces have been put in operation. A good deal of price-cutting is reported, and some of the business is taken at figures which cannot possibly yield a profit. But work keeps men together and plant active, and this is reckoned as something of an asset. The spring branch is a striking example of the cutting of prices that is going on, and the fact that some springs are being sold at less than the Association's figures is regarded as a menace to that organisation's future. Several classes of wire rods have been reduced in price. The business in ferro-managnese continues fair on both home and export account, although, of course, American orders have fallen off. Values are unchanged. The tinplate market has taken a somewhat quieter turn, but most of the works are well booked till the close of the year. At the Exchange meetings last week makers and merchants discussed a further decision by the Welsh tinplate makers, arrived at recently, to advance the minimum price of tinplates by another 3d. per basis box, bringing the minimum up to 19s. 6d. f.o.b. Bristol Channel ports. Merchants are protesting against the makers fixing the selling price without making a percentage allowance to them.

Metals.

Copper.—The market for standard copper may again be reported as consistently firm, values covering a very narrow range in quotations, with fluctuations only varying a few shillings during the past week. Consumption at home, though far from the normal

quantity, is on steady lines, and the demand is fairly well maintained. France also has latterly taken larger quantities, while, in spite of the conditions of the exchange, Germany has re-entered the market, although not to any great extent. Encouraging reports come from America, and the feeling prevailing over there with regard to the future of the market appears to be optimistic. The position, however, in the United States seems a little uncertain, although stocks are certainly being cleared away, but the prospect of increased output is a restraining factor. Copper at its present level of values is still a comparatively cheap metal, but consumption must materially increase before prices are more permanently advanced. Current quotations :—*Cash* : Wednesday, £63 7s. 6d. ; Thursday, £63 5s. ; Friday, £63 7s. 6d. ; Monday, £63 5s. ; Tuesday, £62 17s. 6d. *Three Months* : Wednesday, £64 5s. ; Thursday, £64 2s. 6d. ; Friday, £64 5s. ; Monday, £64 2s. 6d. ; Tuesday, £63 15s.

Tin.—Market conditions with regard to this metal continue active, with rather more buying on the part of consumers, while America is also taking more interest of late. Sales are reported in the East amounting to a good tonnage. Advices from Hong Kong indicate that the position there is unchanged ; stocks are low and producers, in spite of the fall in silver and the consequent depreciation of the Hong Kong dollar, refuse to sell. It is stated that the Federated Malay States Government has withdrawn its stock of about 10,000 tons of tin from the Straits Trading Company, and placed it in Government warehouses. The object of this move is not clear. Possibly the Government only wish to reduce warehousing expenses, but, on the other hand, it may be their intention to liquidate with the smallest possible degree of publicity. Current quotations :—*Cash* : Wednesday, £182 5s. ; Thursday, £178 10s. ; Friday, £177 10s. ; Monday, £178 7s. 6d. ; Tuesday, £178. *Three Months* : Wednesday, £182 17s. 6d. ; Thursday, £179 5s. ; Friday, £178 2s. 6d. ; Monday, £179 2s. 6d. ; Tuesday, £178 15s.

Spelter.—The market for this metal maintains its strength, scarcity of supplies and substantial "bear" operations infusing considerable animation in the business transacted of late. The high prices have induced sales of American spelter for export to this country, state Rudolf Wolff & Company, but owing to consumption in America having been for some months in excess of supply, the surplus for export can only be on a limited scale. On the Continent the position is strong, there being no appreciable tonnage available for export. Current quotations :—*Ordinary* : Wednesday, £39 ; Thursday, £39 2s. 6d. ; Friday, £39 5s. ; Monday, £38 7s. 6d. ; Tuesday, £37 15s.

Lead.—Quieter conditions have been in evidence of late in the market for soft foreign pig, chiefly affecting forward business. The tendency of the market is firm, and with trade slowly improving it seems more probable that an advance in prices will take place. These conditions, however, must be ascribed more to a certain reticence on the part of sellers than to any particular expansion in the demand. Current quotations :—*Soft foreign (prompt)* : Wednesday, £26 10s. ; Thursday, £26 5s. ; Friday, £26 2s. 6d. ; Monday, £26 2s. 6d. ; Tuesday, £26 10s.

Contract Open.

Toronto, Canada, November 28.—The Department of Works of the City of Toronto invites tenders for the supply of 242 lengths of 20-in. cast-iron pipe for high-pressure fire service mains; 12 ft. long exclusive of the hub, with thickness of metal about 1½ in. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Room 47.)

Foundry Query.

A Steel-making Alloy.

I shall be pleased if any of your readers can give me the name of any firm handling Dartrian or Dartum metal.—"PHYSIC."

Company News.

Milford Haven Electric Welding Company, Limited, 129, Bute Street, Cardiff. Capital £2,000. Permanent managing director: D. W. Thomas.

Roberts Bros. (Engineers), Limited, Bradford.—Capital £1,500.

Robson Refractories, Limited, 1, North Road, Darlington, Durham.—Capital £15,000 in £1 shares (5,000 preference and 10,000 ordinary). Directors: E. C. Robson and W. Thiemann. Secretary, N. F. R. Dinsdale.

R. S. Thacker & Company, Limited, Granville House, Arundel Street, Strand, London, W.C.2.—Capital £1,000 in £1 shares. Engineers. Directors: R. S. Thacker and Capt. B. I. Winnall.

Switches, Limited, 281-3, Gray's Inn Road, London, W.C.1.—Capital £1,000 in £1 shares. General engineers. Directors: S. W. Wilkins, H. H. Supper and A. G. Joiner.

The Barrowfield Iron Works, Limited, 100, Fordneuk Street, Bridgeton, Glasgow.—Capital £30,000 in £1 shares, to acquire and carry on the undertaking of the Barrowfield Iron Works, Limited, in voluntary liquidation.

Ultimax Manufacturing Company, Limited, 70-80, Cornish Street, Sheffield.—Capital £1,000 in £1 shares. Engineers, etc. Directors: A. C. J. Charlier (chairman), E. R. Wikeley, A. E. Coyne and F. A. Charlier.

Brown, Bayley's Steel Works, Limited.—Loss, £66,883; brought forward, £20,040; debit balance on revenue account, £46,843.

Weardale Lead Company, Limited.—Profit, £12,296; deficit in accounts for 1921, £3,286; set aside for corporation tax, £250; credit balance, £8,759; dividend, 6 per cent., £5,875; carry forward, £2,884.

Brett's Stamping Company, Limited. — Loss, £3,523; brought forward, £5,229; transferred from general reserve, £5,000; available, £6,706; dividend, 5 per cent. on ordinary, less tax; carry forward, £4,412.

Birmingham Aluminium Casting (1903) Company, Limited.—Profit, £5,791; brought forward, £27,966; dividend, 7 per cent. cumulative preference shares; ordinary dividend, 5 per cent., free of tax; carry forward, £23,757.

W. H. Dorman & Company, Limited.—Net surplus, £10, after providing for interest on 8 per cent. participating seven-year notes and taking credit for £28,676 taxes recovered. Board state that £30,000 required for working capital, and propose to create £150,000 10 per cent. second debentures, of which £80,000 will be offered to shareholders.

A New American Foundry Technical Association.

A new society has been formed at Quad City, Rock Island, Illinois. The second meeting was held on October 16, with an attendance of 90, when Dr. Richard Moldenke, Watchung, N.J., gave an address on general foundry practice. The association had a representative attendance from 27 gray iron, malleable, steel, brass and aluminium foundries. A. E. Hageboeck is president; John Ploehn, vice-president; and R. L. Van Alstyne, secretary and treasurer of the association.

MR. B. D. FRANK DOCKER, managing director of Docker Bros., Limited, and a director of the Metropolitan Carriage, Wagon and Finance, Corporation, Limited, has been elected a director of the Anglo-Argentine Tramways Company.

CUMBERLAND iron ore miners wages are now as follows (per day or shift) : Underground workers.—Miners working bargains, 9s. 2d. ; miners minimum, 6s. 6d. ; first-class or leading labourers, 5s. 11½d. Surface workers.—Winding enginemen, 8s. 1½d. ; joiners, 8s. 8½d., plus 6d. tools allowance ; chargemen and mineral shot borers, 8s. 8½d., plus 3d. per foot ; blacksmiths, 8s. 8½d. ; other grades are increased by amounts varying from one farthing to one penny per shift.

THERMAX Core and Mould OVENS Excel all other Designs — The Manchester Furnaces, Ltd. — Ashton New Road — Manchester

Telephone: 21, Penistone. Telegrams: "Durranns, Penistone."

ESTABLISHED 1863.

JAS. DURRANS & SONS., LTD.

Phoenix Works, Penistone NEAR SHEFFIELD.

BLACKING
PLUMBAGO
CORE GUM
WHITE DUST
COAL DUST

Manufacturers of

FOUNDRY EQUIPMENTS.

Ladles, Cupolas, Fire Bricks, Ganister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

Write for illustrated catalogue on Blacking and Foundry Requisites, also for our latest Price List.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.
CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

Established 1872. *Telegraphic Address: "Steel, Glasgow."*

GANISTER, CUPOLA BLOCKS, FIRE BRICKS, FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.,

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	62	17	6
Three months	63	15	0
Electrolytic	70	10	0
Tough	66	0	0
Best selected	66	0	0
Sheets	96	0	0
India	84	0	0
Wire bars	70	12	6
Do. Dec.	70	12	6
Do. Jan.	70	12	6
Ingot bars	70	12	6
H.C. wire rods	75	0	0
Off. aver. cash, Oct.	62	16	$5\frac{1}{32}$
Do. 3 mths., Oct.	63	8	$11\frac{9}{11}$
Do. Settlement Oct.	62	15	$10\frac{10}{11}$
Do. Electro, Oct.	71	0	0
Do. B.S., Oct. ..	66	11	$1\frac{6}{7}$
Aver. spot price, copper, Oct. ..	62	15	$4\frac{2}{7}$
Do. Electro, Oct.	71	5	11

Solid drawn tubes .. 13½d.
Brazed tubes .. .. 13½d.
Wire .. .. .. 10½d.
Yellow metal rods .. 6½d.
Do. 4x4 Squares .. 8½d.
Do. 4x3 Sheets .. 9½d

BRASS.

Solid drawn tubes .. 11½d.
Brazed tubes 13½d
Rods, drawn .. .. 10½d.
Rods, extruded or rolled 6½d.
Sheets to 10 w.g. .. 10d.
Wire .. .. .. 9½d.
Rolled metal .. 9½d.

TIN.

Standard cash	178	0	0
Three Months	178	15	0
English	178	0	0
Bars	180	0	0
Chinese	177	0	0
Straits	179	15	0
Australian ..	179	10	0
Eastern	182	0	0
Banca	178	5	0
Off. aver., cash, Oct.	170	12	$4\frac{7}{11}$
Do. 3 mths., Oct.	171	11	$4\frac{3}{11}$
Do. Sttlment. Oct.	170	12	$0\frac{6}{11}$
Aver. spot, Oct. ..	170	11	3

SPELTER.

Ordinary ..	37	15	0
Remelted ..	34	0	0
Hard	27	10	0
Electro 99.9 ..	40	10	0
English	38	10	0
India	28	10	0
Prime Western ..	38	7	6
Zinc dust ..	49	0	0
Zinc ashes ..	11	0	0
Off. aver., Oct.	34	0	$6\frac{3}{22}$
Aver., spot, Oct.	34	11	$4\frac{1}{2}$

LEAD.

Soft foreign ppt ..	26	10	0
English	27	10	0
Off. average, Oct.	25	1	3
Average spot, Oct.	25	11	3

ZINC SHEETS.

Zinc sheets, English	41	10	0
Do. V.M. ex. whf.	42	0	0
Dutch	42	0	0
Rods	49	0	0
Boiler plates	40	10	0
Battery plates ..	42	10	0

ANTIMONY.

English regulus ..	27	0	0
Special brands ..	33	10	0
Chinese	25	5	0
Crude	17	10	0

QUICKSILVER.

Quicksilver 12 0 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% 11 0 0
75% 19 10 0

Ferro-vanadium—
35/40% 17/- lb. va.

Ferro-molybdenum—
70/75% c. free 9/6 lb. mo.

Ferro-titanium—
23/25%, carbonless 1/2 lb.

Ferro-phosphorus, 20/23%, £24

Ferro-tungsten—
80/85%, carbon free 1/5 lb.

Tungsten metal powder—
98/99% .. .. 1/11 lb.

Ferro-chrome—
4/6% car. £22 5
6/8% car. .. £21 5
8/10% car. .. £20 10

Ferro-chrome—
Max. 2% car. .. £54 0
Max. 1% car. .. £65 0
Max. 0.70% car. .. £72 10
67/70%, carbonless 1/6½ lb.

Nickel—99%, cubes or pellets .. £137 10

Cobalt metal—98/99% 11/3 lb.

Aluminium—98/99% £100

Metallic Chromium—
96/98% .. .. 4/9 lb.

Ferro-manganese (net)—
76/80%, loose .. £15
76/80%, packed .. £16
76/80%, export .. £14 10

Metallic manganese—
94/96%, carbonless 2/3 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten .. .. s. d. 2 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ⅛ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness .. .. 3d. lb.
Bevels of approved sizes and sections .. 6d. lb.
If in coils .. .. 3d. lb.
Packing .. ..£3 ton.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces .. .. 3d.
Turnings and swarf .. 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d
Heavy Steel	3	12	6
Bundled steel & shearings	3	0	0
Mixed iron & steel ..	3	0	0
Heavy cast iron ..	3	10	0
Good machinery for foundries	3	15	0
	3	15	0
	4	0	0

Cleveland—			
Heavy steel ..	3	8	0
Steel turnings ..	2	14	0
Cast-iron borings	2	12	6
Heavy forge ..	3	12	6
Bushelled scrap ..	2	16	3
Cast-iron scrap ..	3	15	0

Lancashire—			
Cast iron scrap ..	3	16	3
Heavy wrought ..	3	2	6
Steel turnings ..	2	2	6

London—	£	s.	d.
Copper (clean) ..	56	0	0
Brass (clean) ..	32	0	0
Lead (less usual draft)	22	0	0
Tea lead	20	0	0
Zinc	22	10	0
New aluminium cuttings ..	60	0	0
Braziery copper ..	48	0	0
Gun metal ..	42	0	0
Hollow pewter ..	130	0	0
Shaped black pewter	90	0	0

Above are merchant's buying prices delivered yard.

PIG-IRON.

N. E. Coast—
Foundry No. 1 .. 97/6
Foundry No. 3 .. 92/6
Forge No. 4 .. .. 85/-
Mottled 81/6
Hematite No. 1 .. 93/9
Hematite M/Nos. .. 93/-

Midlands—
Staffs. common .. —
„ part-mine forge —
„ „ foundry —
„ Cold blast 180/- 200/-
„ basic .. .. —

Northants forge 70/- to 72/6
„ foundry No. 3 77/6 „ 80/-
„ basic 80/-

Derbyshire forge .. 75/-
„ foundry No. 3 82/6
„ basic .. 80/-

Scotland—
Foundry No. 1 .. 101/6
„ No. 3 .. 96/6
Hematite M/Nos. .. 107/6

Sheffield (d/d district)—
Derby forge 85/6
„ foundry No. 3 87/6
„ basic .. .. —
Lincs. forge 86/6
„ foundry No. 3 87/6
„ basic 86/6
E.C. hematite .. 102/6
W.C. hematite 105/-
All d/d in the district.

Lancashire (d/d eq. Man.) —
Derby forge .. .. —
„ foundry No. 3 90/-
Northants foundry No. 3 .. .. —
Cleveland foundry No. 3 .. .. —
Staffs. foundry No. 3 —
Lincs. forge .. .. —
„ foundry No. 3 —
Summerlee foundry .. 114/6
Glengarnock foundry 116/6
Gartsherrie foundry 116/6
Monkland foundry .. 114/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.
Bars (cr.)	£10 10 to 11	10	0
Angles	£10 15 to 11	15	0
Tees to 3 united ins.	£11 to £12		
Nut and bolt ..	9	12	6
Hoops	14	0	0
Marked bars (Staffs.) ..	13	10	0
Gas strip	£10 10 to 10	15	0
Bolts and nuts, ⅞ in. × 4 in.	17	10	0

Steel—			
Ship plates	£9 to 9	10	0
Boiler plates ..	12	10	0
Chequer plates	10	5	0
Angles	£8 12 6 to 9	0	0
Tees	£9 12 6 to 10	0	0
Channels ..	8	10	0
Joists	9	0	0
Rounds & squares 3-in. to 5½in. ..	9	5	0
Rounds, under 3in. to ⅞in. ..	8	15	0
Flats, over 5in. wide and up ..	9	10	0
Flats 5in. to 1½in.	8	15	0

	£	s.	d
Rails, heavy ..	8	15	0
Fishplates ..	14	10	0
Hoops	11	10	0
Black sheets, 24 g.	11	15	0
Galv. cor. sheets, 24 g.	17	0	0
Galv. fencing wire, 8 g. plain ..	16	0	0
Rivets, ½ in. dia	12	15	0
Billets, soft	6 0 0 to 7	0	0
Billets, hard	7 0 0 to 8	0	0
Sheet bars	6 17 6 to 7	7	6

PHOSPHOR BRONZE.

	Per lb basis
Strip	1 3
Sheet	1 3½
Wire	1 3½
Rods	1 2½
Tubes	1 6
Castings	1 1

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.
CHARLES CLIFFORD & SON LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	11d. to 1/5
Rolled—	
To 9 in. wide	1/5 to 1/11
To 12 in. wide	1/5½ to 1/11½
To 15 in. wide	1/6 to 2/0
To 18 in. wide	1/6½ to 2/0½
To 21 in. wide	1/7½ to 2/1½
To 25 in. wide	1/8½ to 2/2½
Ingots for spoons and forks ..	11d. to 1/5
Ingots rolled to spoon size ..	1/2 to 1/8
Wire round—	
3/0 to 10. G. ..	1/8½ to 2/3½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	31.14
No. 2 foundry Valley ..	29.00
No. 2 foundry, Birm. ..	25.00
Basic	30.96
Bessemer	34.27
Malleable	31.96
Grey forge	30.77
Ferro-manganese 80 % delivered	—
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y, at mill	43.00
Bess. billets	38.00
O.-h. billets	38.00
O.-h. sheet bars ..	38.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.32
Steel bars	2.00
Tank plates	2.00
Beams, etc.	2.00
Skelp, grooved steel ..	2.00
Skelp, sheared steel ..	2.00
Steel hoops	2.90
Sheets, black, No. 28 ..	3.35
Sheets, galv., No. 28 ..	4.50
Sheets, blue an'l'd, 9&10	2.60
Wire nails	2.70
Plain wire	2.45
Barbed wire, galv. ..	3.35
Tinplate, 100-lb. box ..	$4.75

COKE (at ovens).

Welsh foundry	35/-
„ furnace	26/-
Durham & North. fdy.	27/6 to 30/-
„ furnace	22/6 to 25/6
Other Districts, foundry	25/- to 30/-
„ furnace	21/6 to 24/6

SWEDISH IRON.

Bars, hammered basis sizes Basis price £22 to £23

	£ s. d.
Rolled Ordinary—Assortment ..	18 0 0
Nail Rods—Square, round and flats ..	to 18 10 0

Keg Steel nom. £38 to £40
Faggot Steel nom. £30 to £32

Blooms—
Single welded .. £10 to £11

Billets—
Single and double welded £13 to £14

Pig-Iron—
Grey, white or mottled .. £7 to £7 10 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

Up to and incl. 6 in.

Gas ..	57½%
Water ..	52½%
Steam ..	47½%

Tube prices are now free.

TINPLATES.

I.C.Cokes,	20×14, box	19/6
„	28×20, „	40/-
„	20×10, „	28/9
„	18¾×14, „	20/1½
I.X.	„	46/-
I.X.X.	„	52/-
F.C.B.Y.	21×13⅝ „	36/6
C.V.B.G.	16¾×15, „	34 9
I.C.W.	20×14, „	17/10½
„	28×20, „	35/6
„	20×10, „	24/10½
„	18¾×14, „	18/4½
Terneplates,	28×20. „	36/-

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Nov. 15	63	7	6	No change	
„ 16	63	5	0	dec.	2/6
„ 17	63	7	6	inc.	2/6
„ 20	63	5	0	dec.	2/6
„ 21	62	17	6	„	7/6

Electrolytic Copper.

Nov. 15	70	15	0	No change	
„ 16	70	15	0	„	
„ 17	70	15	0	„	
„ 20	70	15	0	„	
„ 21	70	10	0	dec.	5/-

Standard Tin (cash).

Nov. 15	182	5	0	inc.	45/-
„ 16	178	10	0	dec.	75/-
„ 17	177	10	0	„	20/-
„ 20	178	7	6	inc.	17/6
„ 21	178	0	0	dec.	7/6

Tin (English ingots)

Nov. 15	182	5	0	inc.	45/-
„ 16	178	10	0	dec.	75/-
„ 17	177	10	0	„	20/-
„ 20	178	10	0	inc.	20/-
„ 21	178	0	0	dec.	10/-

Zinc Sheets (English)

Nov. 15	41	10	0	inc.	10/-
„ 16	41	10	0	No change	
„ 17	41	10	0	„	
„ 20	41	10	0	„	
„ 21	41	10	0	„	

Spelter (ordinary).

Nov. 15	39	0	0	inc.	2/6
„ 16	39	2	6	„	2/6
„ 17	39	5	0	„	2/6
„ 20	38	7	6	dec.	17/6
„ 21	37	15	0	„	12/6

Lead (English).

Nov. 15	27	10	0	No change	
„ 16	27	5	0	dec.	5/-
„ 17	27	5	0	No change	
„ 20	27	5	0	„	
„ 21	27	10	0	inc.	5/-

THE
ARMITAGE WORKS Co., Ltd.
Manufacturers of
Highly Refractory Bricks and Blocks
FOR ALL PURPOSES.

SPECIALITIES:
CUPOLA LININGS.
Ladle Bricks for Siemens Ladles.
Chequer Bricks, etc., for Siemens Furnaces.
Gas Producer Linings.

GROUND GANISTER
for Iron, Steel, and Brass Furnaces. Forced Draught Brass Furnaces. Semi-Silica or Semi-Ganister Bricks. Silica Cement.

DEEPCAR, Near Sheffield.

SHROPSHIRE IRON Co., Ltd.

Works:—
Hadley, Shropshire.

London:—10, Fush Lane Cannon St., E.C.4.

Telegrams:—
Sun, Wellington, Salop.
Sunbrand (Cannon), London.

Telephone:—
11 Wellington, Salop.
5959 Central.

BARS, HOOPS, SECTIONS & WIRE
in IRON, STEED, COPPER and BRONZE.

Galvanised Telegraph, Telephone, Cable and Trolley Wire
To all Specifications.

Contractors to H.M. Government (Admiralty, G.P.O., India Office, War Office, Colonies), English and Foreign Railways, &c.

BEST H. C. COPPER & BRONZE WIRE a speciality.

Medals:—Sydney (Bronze) 1879, New Zealand (Gold) 1882, Liverpool (Silver) 1886, Adelaide (Gold) 1887, Franco-British Grand Prix (Highest Award) 1908.

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT
5, MURZBAN ROAD, BOMBAY.
1, LALL BAZAR CALCUTTA.

REGISTERED TRADE MARK

1, HONG KONG ROAD, SHANGHAI
31, RAFFLES PLACE, SINGAPORE.
JAVA STREET, KUALA LUMPUR.
5 SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.

PIG IRON
SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.
IRON & STEEL SCRAP
COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,
ROYAL EXCHANGE, MIDDLESBROUGH.
93, HOPE STREET, GLASGOW.

SITUATIONS VACANT AND WANTED.

THE Lancashire Branch of the Institution of British Foundrymen beg to announce that several members, who have had varied experience as Foremen, etc., are at present disengaged. Employers who are in need of Foremen or other members of their foundry staff are invited to communicate with the Honorary Secretary, T. MAKEMSON, 21, Beresford Road, Stretford, Manchester

FOUNDRY Metalurgist and Chemist, M.Inst.B.F., desires responsible position, control of Cupolas and Laboratory; Birmingham district preferred. Experience: Melting of Grey iron, "Semi-steel," also Brass, Gunmetal, Aluminium alloys; good organiser; excellent references.—Apply, Box 302, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WANTED.—FOREMAN PATTERNMAKER, experienced in heavy marine engine, general machine tools and special pipe patterns.—Apply, THE SHEEPBRIDGE COAL & IRON COMPANY, LIMITED, Chesterfield.

FOUNDRY FOREMAN wanted for London district; must have good knowledge of general machine castings, also thoroughly understands mixture of metals; no one unless thoroughly experienced need apply.—Reply, stating wage required, to Box 294, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WANTED, FOREMAN for small Foundry, close London. Light, cast iron and semi-steel, state age, experience, and salary, Box 296, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WANTED.—Metallurgist for large Industrial Plant; must be conversant with the latest methods of heat treatment tempering and case hardening of steel; applicants should state qualifications, experience, past and present employers, which will be treated confidentially. — Address, "Metallurgist," WM. PORTEOUS & COMPANY, Advertising Agents, Glasgow.

WANTED.—FOUNDRY FOREMAN, experienced in moulding large marine castings and general heavy machine tool castings.—Apply, THE SHEEPBRIDGE COAL & IRON COMPANY, LIMITED, Chesterfield.

TENDER.

GLASGOW CORPORATION TRAMWAYS.
STEEL RAILS AND FISHPLATES.

THE CORPORATION OF GLASGOW are prepared to receive TENDERS for the SUPPLY of the undernoted:—

2,500/3,000 Tons Steel Rails, B.S. Section No. 8.
500 Tons Fishplates for above.
1,200 Tons Special Section 5-in. Rail.
21 Tons Fishplates for above.

Specifications, Forms of Tender, and Drawings can be obtained on application to Mr. James Dalrymple, General Manager, 46, Bath Street. Sealed Tenders, marked outside "TRAMWAYS—TENDER FOR STEEL RAILS," must be lodged with the Subscriber on or before TUESDAY, 28th NOVEMBER current.

The lowest or any Tender may not be accepted.

J. LINDSAY, Town Clerk.

City Chambers, 14th November, 1922.

PATENT.

ADVICE and Handbook Free.—KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Reg. Patent Agent, 146a, Queen Victoria Street, E.C.4.

THE PROPRIETOR of the Patent No. 138900 for Bessemerizing iron is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to HASELTINE LAKE & COMPANY, Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

THE Proprietor of British Patent No. 147931, dated April 8, 1916, relating to "METAL-HEATING FURNACES," is desirous of entering into arrangements by way of a licence or otherwise on reasonable terms for the purpose of exploiting the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Woolworth Building, New York City, N.Y., U.S.A.

AGENCIES.

AGENCY for Non-Ferrous Metals desired by Sheffield firm; good connection in Iron and Steel and Brass Trades.—Box 292, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

SALE BY AUCTION.

By order of the Senior Official Receiver in Companies Liquidation in the Matter of the Dreadnought Portland Cement Company, Limited (in Liquidation).

BARRINGTON,
near CAMBRIDGE,
1½ mile from Foxton Station, G.E.R., and six miles from Cambridge.

SALE of
the valuable FREEHOLD PROPERTY
known as
THE DREADNOUGHT PORTLAND CEMENT WORKS,
comprising
ABOUT 150 ACRES of valuable MINERAL-BEARING LAND, eminently suitable for the manufacture of Portland cement,
with the substantially-built
POWER HOUSE, BOILER HOUSE, CHIMNEY SHAFT 150 ft. high,
concrete raft, brick wall, offices, mess house, lime kiln, farm buildings, and artesian well thereon.

The desirable FREEHOLD RESIDENCE,
built for the manager,
containing three sitting rooms, six bed rooms, bath (h. and c.), and good domestic offices, garage, and garden, the whole having an area of two acres.

The valuable RAILWAY SIDING,
about 1¼ mile in length,
connecting the works with the Great Eastern line (Cambridge branch) at Foxton Station, together with the land over which it runs, comprising an area of about 19 acres, and the whole of the
VALUABLE RAILWAY MATERIALS,
of which it is constructed, consisting of approximately 14,900 ft. of 75-lb. steel rail, 7,760 ft. of 6-strand galvanised wire fencing with reinforced concrete posts, bridge with iron girders, and a large quantity of sleepers, dogs, switches, points, slag, etc.

Possession of the whole, including the manager's house, will be given on completion.

The attention of Cement Manufacturers, Builders, Steel Manufacturers, and Speculators is directed to this sale, as affording a great opportunity for enterprise in the future.

The property only requires the installation of machinery to make it a going concern, as most of the spade-work has already been accomplished.

To be SOLD by AUCTION,
IN ONE LOT,
and if not sold, offered separately, by
MR. WILLIAM YOUNG
(in conjunction with Messrs. ROBINSON & ROODS),
at WINCHESTER HOUSE, OLD BROAD STREET, London, E.C. (Room 23),
on MONDAY, November 27, 1922,
at three o'clock precisely.

Particulars and plans and conditions of sale may be obtained of Messrs. Lawrance, Webster, Messer, and Nicholls, Solicitors, 14, Old Jewry Chambers, E.C.2; Messrs. Robinson & Roods, Surveyors, 37, Bedford Row, W.C.1; and of Mr. William Young, Auctioneer, 4, St. Peter's Street, St. Albans, Herts.

MACHINERY.

6-Wheel Coupled Saddle Tank Locomotive (Manning Wardles), with inside cyls., 12 in. diam. x 18 in. stroke, 4 ft. 8½ in. gauge, 140 lbs. W.P., sale or hire. 3-ton "Grafton" Loco. Steam Crane, with 27 ft. 6 in. steel latticed jib, all motions by steam, 4 ft. 8½ in. gauge, boiler for 70 lbs. W.P. New 3-ton Hand Derrick Crane, with 45 ft. timber jib, two wire ropes. Portable 6 ft. Mortar Mill, with Engine and Boiler, having steel girder carriage with flat-faced road wheels. 9 ft. Perforated Grinding Mill, over-driven, with gathering-up pan underneath, grids with 3 in. x 1/16 in. slots. 20 in. x 9 in. Stone Breaker (Goodwin-Barsby), having "Era" manganese steel jaws. 3-ton "Avery" Dormant Weighing Machine, with platform 5 ft. x 4 ft., fitted with F.B. rails 2 ft. gauge.

Catalogue of Stock Machinery, 6,000 Lots.
Free on Application. Inspection Invited.

THOS. W. WARD, LTD.,
ALBION WORKS,
SHEFFIELD.